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SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS

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Some Aspects of Time-Lapse Cinematography and Related Arts

By HENRY ROGER

Time-lapse photography has many applications including medical research, law, industry and agriculture. A discussion of medical research describes studies of normal and malignant cells of tissue and blood; human capillaries and studies on human eyes with an automatic "eye movement" camera. Time-lapse photography has also played an important part in a patent litigation. Microscopic studies at low and high temperatures (freezing of motor oil, and baking) are discussed. This technique is also used in the study of plant growth.

Time-lapse cinematography is as old as the motion-picture art itself. By slowing down or speeding up frequencies of pictures which have been taken with the motion-picture camera, and projected at normal speed, we have become the masters over the elements of time; thus, many actions which were too slow or too fast for the human eye to conceive may conveniently be observed at understandable speeds.

In this paper we are mainly concerned with the speed-up process as opposed to the slow-down process, generally known as "slow-motion" or "high-speed" photography, respectively.

For approximately 30 years of the motion-picture art the standard projection speed was set to be 16 frames/sec. At the advent of sound the standard speed was increased for technical reasons to 24 frames/sec. Scenes which were taken before, say 1928, and sometimes shown today, seem to be hurried up; this however, should not be considered useful time-lapse cinematography. The most useful range of the art, in the author's opinion, is from 8 frames/min to one frame/hr.

The art of time-lapse cinematography has long been recognized as a scientific tool, especially in biology and medicine where the motion-picture camera (Fig. 1) has been used to register slow actions such as the movements under the microscope of living cells of animal and plant life.

Time-Lapse in Medical Research

The author's experiments with time-lapse cinematography date back to about the winter of 1923 when he became a research associate of the late Dr. Alexis Carrel at the Rockefeller Institute for Medical Research. At that time microscopic studies were made on tissue and blood cells, both normal and malignant. The author's work was mainly concerned with the physical behavior of cells, while other departments were engaged in the study of their physiology and chemistry.

Dr. Carrel and his staff were engaged in the study of living cells *in vitro*, continuing the work of Dr. G. G. Harrison of Yale University. The technique is as follows: A small fragment of heart tissue of chick embryo is placed under sterile conditions in a small glass vessel in which a nutrient fluid (at that time consisting of crushed embryo juice and later of a synthetic fluid) was added. At body temperature the cells grow and thrive, forming new colonies; after a few days these colonies increase in size many times the size of the original fragment. After two or three days the sealed glass vessel

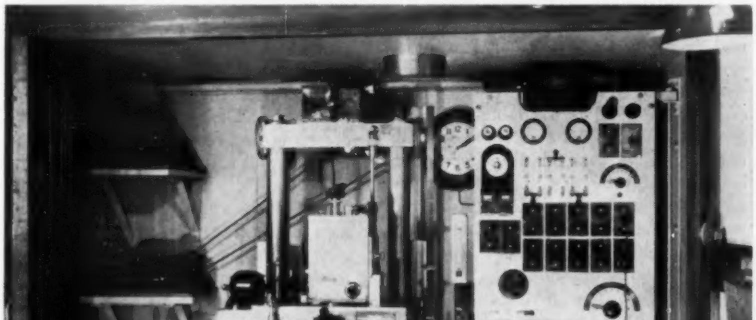


Fig. 1. Microcinema apparatus with professional 35mm camera designed and constructed by the author for medical, bacteriological, biological and technological research (built in 1929).

Presented on October 9, 1957, as a paper and demonstration at the Society's Convention in Philadelphia, by Henry Roger, Rolab Photo-Science Laboratories, Sandy Hook, Conn.
(This paper was first received on September 20, 1957, and in final form on March 27, 1961.)

is opened, the specimen carefully washed in a sterile fluid, and a small fragment of the new growth removed and transplanted into a new sterile glass vessel, in which it again begins to grow in the same manner. In this manner the tissue of the "old strain" has been kept alive since 1912.

Under the microscope, even at high power, the cells seem to be practically motionless and it would be very tiresome to study the growth for hours and days by ordinary observation. This is when the motion-picture camera comes to our aid. An apparatus, of quite simple structure, was designed and built in the fall of 1923 and immediately put to use for the automatic observation by time-lapse, usually at the rate from two to six pictures per minute depending upon magnification. When projected at 16 frames/sec the cells really begin to perform on the screen. Under a relatively low-powered microscope we can observe the growth of cell colonies forming an intricate network; under a high-powered microscope we are able to study the internal structure of a single cell and the function of small cell organs. Under the high-powered microscope the cells seem to move faster because the apparent speed increases in the same ratio as the magnification; also, at high magnification the intensity of the light illuminating the microscopic field decreases in the same ratio; in other words, to obtain good photographic results at high magnification we have to shorten the time-intervals and use stronger light.

Living tissue cells, as seen under the microscope, show very little contrast and have practically no color. It is sometimes extremely difficult even to see a tissue cell. Here again, photography comes to our aid as it enables us to increase the value of contrast so that more details can be seen on the screen than could possibly be seen under the microscope by visual observation. (In recent years phase contrast techniques have helped greatly to bring out structural details of living organisms.)

Although positive film is comparatively slow, the author has frequently used this material in many studies because it gives better black-and-white contrasts and it is less expensive than negative stock. Light and excessive heat are injurious to all cell life, which thrives mainly in the dark. To overcome this difficulty, the light is turned on only at the moment of exposure, and during the long intervals, in between exposures, the light is turned off. With incandescent light sources the problem of controlling the light is simple; a commutator switch synchronized with the camera shutter will turn the light on long enough for the exposure. With arc light, "Pointo" light or any other light source requiring a starting period, a rotating shutter with an open sector synchronized with the open sector of the camera shutter is employed. It is inserted into the light beam before reaching the microscope.

During the author's eleven years at the Rockefeller Institute many interesting films were produced; these not only showed the growth of cells of tissue and blood, but in particular, cell divisions and phagocytosis and a great many details in the structure of normal and malignant cells at low and high power. From time to time other subjects were studied such as the growth of bacterial colonies and the observation by time-lapse of single specimens of bacteria.

A film produced with the late Dr. J. J. Bronfenbrenner, showed, for the first time on a motion-picture screen, the destructive action of bacteriophage on coli bacteria. Single cells have been observed growing larger and larger until they actually burst into small fragments which then spread over a comparatively large area.

Interesting studies were also carried on with the late Dr. Hidayo Nogouchi on trachoma and yellow fever.

Patent Litigation

After leaving the Rockefeller Institute in 1934 the author maintained a great deal of interest in the application of scientific cinematography in other fields. For this reason the Rolab Photo-Science Laboratories were established at that time, in Sandy Hook, Conn.

As an example of the many applications of time-lapse photography, a lawsuit brought by a well-known company may be cited. This company, manufacturers of machinery for mass production of confections, such as ice cream held on wooden sticks, sought out services shortly after the laboratories were established. The patents owned by this company had frequently been infringed upon, and a suit was entered in Federal Court in Philadelphia. The author was called as an expert witness. The defendants in this case claimed that confections with a stick, such as an imitation fruit made from chocolate, were being made in France as long as fifty years ago. The plaintiffs were required to prove that there is a definite adhesion between the stick and the frozen confection i.e., the ice cream. Observation under the microscope and the use of time-lapse cinematogıaphy definitely established that the ice crystals which are formed as the temperature is lowered to freezing actually penetrate into the pores of the wooden stick. Five thousand feet of 35mm motion pictures, showing this phenomenon and others such as various dyes permeating the wood by capillary action, were presented in court to prove that there is a difference between adhesion and mere friction and that when small sticks are simply inserted into chocolate confections, adhesion does not take place.

Apparatus Constructed for Studies of Freezing

In order to demonstrate under the microscope what happens when the temperature is lowered to 32 F and further down to zero a special microcinema freezing apparatus was constructed. (Fig. 2). A coolant, such as isopropyl alcohol, ethylene glycol, etc., was circulated through a copper coil inside a vessel filled with dry ice (carbon dioxide). In order to show specimens at low temperatures a special stage was constructed to fit upon the stage of the microscope. This freezing stage permitted the circulation of the coolant through it. The center had an opening for the light to come through. A large vessel, such as those for experiments with liquid air, was used, and in it was inserted a coil of copper tubing cooled by dry ice. At first a small pump was used to circulate the coolant; later this system was abandoned in favor of simple gravity feed. The temperature on the stage could easily be controlled from room temperature down to below zero by regulating the flow of the coolant.

In a motion picture on motor oils, a well-known laboratory for petroleum research wished to demonstrate the action of an additive to motor oil which prevents the oil from freezing and makes easier winter starting. By means of time-lapse cinematography it was demonstrated how relatively large wax crystals are formed in ordinary motor oil at freezing temperatures, thus stiffening the oil and making it difficult to start the motor in winter. It was in this film demonstrated that the special winter oil with the additive raised the pour point, i.e., kept the oil more fluid for easier starting. The large wax crystals as they formed in ordinary oil were shown on the screen in direct comparison with the relatively small wax crystals formed at the same temperature in the special oil for winter driving.

Process of Baking Studied

Time-lapse cinematography has been used not only to show phenomena connected with freezing, but also to demonstrate processes involved in baking. During a study for the research laboratories of a well-known firm manufacturing margarine, a complete bakery, with mixers and ovens, was set up in our laboratory for the purpose of taking motion pictures of what happens to the texture of dough in the process of baking and how various ingredients contained in the cake mixture are affected during the process. A miniature oven with a heating coil was placed upon the stage of the microscope for a series of experiments which showed microscopically what actually takes place during the baking process. The addition of dyes to the ingredients, filmed with Koda-

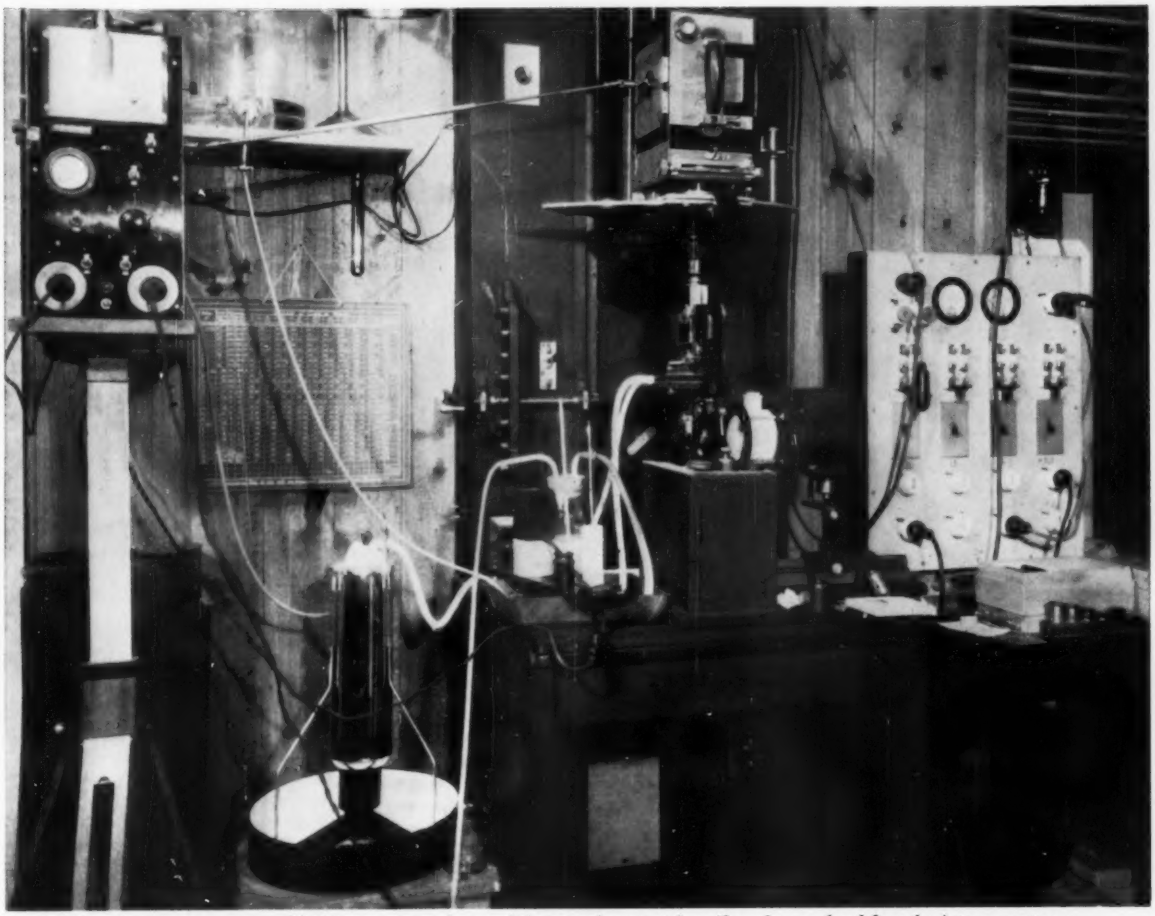


Fig. 2. Microcinema apparatus with 35mm camera for studying specimens at low (freezing and subfreezing) temperatures.

chrome color stock, gave a beautiful demonstration of the process. The dyes, added to the cake mixture for identifying the various ingredients on the screen, and the polarized light employed for identifying sugar and salt crystals, added interest and beauty to a spectacular demonstration.

Variations of this technique were later employed on several occasions to show the process of baking and also the behavior of various chemicals at different temperatures. These problems were brought to us by testing laboratories and food concerns.

Clinical Study of the Human Eye: Apparatus Designed

We now turn our attention to another phase of stop-motion photography which has offered a great many problems and challenges. During the Second World War a pharmaceutical laboratory wished to study the human eye in order to demonstrate the vitamin B2 deficiencies revealed in the eye. Photographs had previously been made with black-and-white negative material; however, in this case color photographs were to be obtained. Naturally the human eye is sensitive to strong lights. Light intensities required for exposure of color stock could have proved injurious.

We constructed an apparatus with a powerful arc light and a rotating-shutter assembly which permitted exposures of about one-two hundredth of a second and less. During the focusing period strong light-absorbing filters were inserted into the beam of light to reduce it to a tolerable intensity. A specially constructed reflex camera triggered at the moment of exposure a circuit to actuate a solenoid which then released the rotating shutter for the short exposure. This rotating shutter at focusing position contained the light and heat-absorbing filters mentioned above. Focusing at details of the human eye in any camera or in other optical instrument is quite difficult as the eye moves constantly in and out of focus, especially in mental patients. This apparatus solved the problem. Many interesting color photographs of the interior of the human eye showing the blood vessels and the corona in beautiful colors were obtained as part of a motion picture on vitamin deficiencies and malnutrition.

During World War II a quite difficult problem was brought to us by a foundation which wished to study the eye movement in normal human beings as compared with the eye movement of those with mental defects. This problem involved the measurement in fractions of seconds of a coordinated movement composed of horizontal and vertical movements of the eye, with a timing factor added.

A camera (Fig. 3), especially constructed for a research foundation, was employed in its laboratory to study differences in ocular behavior in the two contrasting patterns of attention demarcated in their research. One pattern (ditention) embodies a deflection of attention which is regarded by some authorities as the underlying cause of conflict and disorder, special as well as clinical. The other (cotention) represents an efficiently integrated pattern governing the organism's relation to the environment.

Experiments were carried on for a number of months in our laboratory for the development of apparatus exactly suited to the purpose. The equipment consisted of a camera three feet long

Fig. 3. Camera and apparatus constructed for the specific purpose of clinical study of eye movements.

which produced on 35mm motion-picture film an enlarged picture of a target reflected from the cornea of the human eye, with a tolerable distance from the objective. The transparent target, after many experiments, evolved into the shape of a circle or ring with a tangential bar which was rotated one revolution per second, driven by a synchronous motor properly geared down. The light source behind this rotating shutter was a General Electric flashtube which could be set to flash 10, 20 or 30 times/sec. The electronic equipment was built into a separate section with a control panel in front to be operated by a doctor or nurse.

The person to be examined was placed in front of the camera and was requested to observe a black test-board with five properly distributed miniature light bulbs placed behind tiny openings. One bulb indicated the center, while four bulbs were distributed one in each corner. These bulbs could be individually lighted from the control panel by pushing respective buttons, thus the patient's eyes could be directed around the limits of the board. When the equipment was started to take say 10 exposures/sec, a star with 10 bars was obtained on each frame (Fig. 4), providing the eye was perfectly still and looking at the center. In a mental patient, in whom the eye is not steady, an irregular pattern was obtained, the 10 bars showing an irregular pattern and demonstrating the difference between the normal eye and the abnormal eye. Further studies showed very clearly the eye movement of patients when requested to look at the test board according to various patterns as directed from the panel.

The various figurations were studied on these photographic records on 35mm film by projecting them single-frame down on a drafting board by means of a special vertical single-frame projector. The images, thus obtained then were accurately analyzed by measuring the distances from one point to the next and by checking the time in fractions of seconds by the angular position of the bar which appeared on each impression.

For those interested in the apparatus and its technique a booklet, available from the author, describes the apparatus and the medical problems involved.*

Problems of Photographing Capillary Action

Another interesting problem was presented by the Hospital of the Rockefeller Institute. The problem here consisted of the study of human capillaries as related to heart conditions. In order to lead to the solution of this problem we should deviate for a moment to a problem which was solved interestingly during the War when the author was a naval aviator and as such tried to photograph submarines in various stages of submersion. With the aid of polarized light the reflections of the water surface were eliminated, and thus was eliminated the glare which would have made this sort of photography impossible. This same principle, i.e., the use of polarized light, was employed in the Hospital's problem to eliminate the surface glare as reflected from the surface of the skin. Cedarwood oil was used to penetrate optically the thin first layer (epidermis) of the skin, thus making it possible to observe the blood flow near the fold of the fingernails in a human being (Fig. 5). Motion pictures have been obtained, taken at the rate of 10 to 20 frames/sec. Films, thus obtained, were not only shown by projecting them on the screen but they also were used for very accurate

* Since this article was submitted a new apparatus "Eye Movement Camera II" has been completed in 1960 and furnished to the Vanderbilt University. A description will be available from the author at a later date.

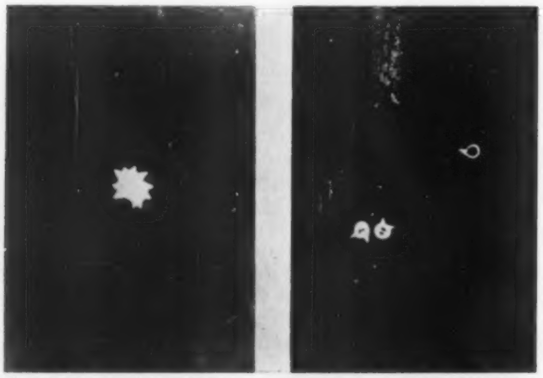


Fig. 4 Comparison of eye movements as a diagnostic aid. Starred pattern (left) shows eye of normal person; pattern at right shows eye movement of mentally disturbed patient, both asked to look at the small illuminated point at center of test board.

Fig. 5. Blood flow near patient's fingernails photographed using polarized light from high-intensity arc lamp.

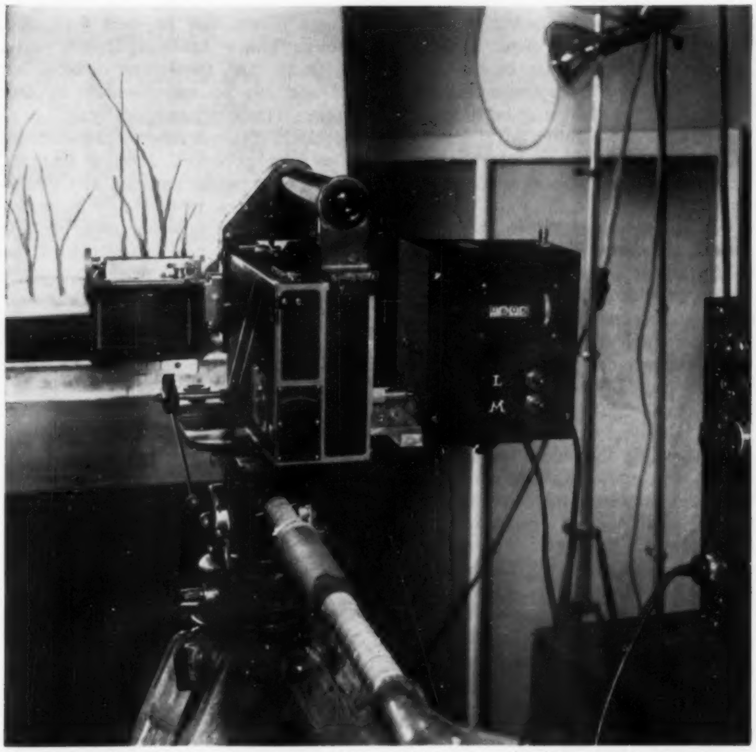


Fig. 6. Specially designed apparatus for studying growth of plants by time lapse. D.P.D.T. Relay is used to change light source from artificial daylight plus heat (for growth) to powerful light of 3200 K for exposure for color.

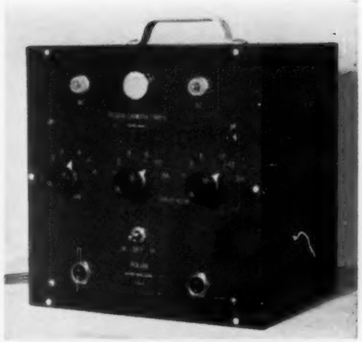


Fig. 7. Roger Camera Timer "I" (Intervalometer).

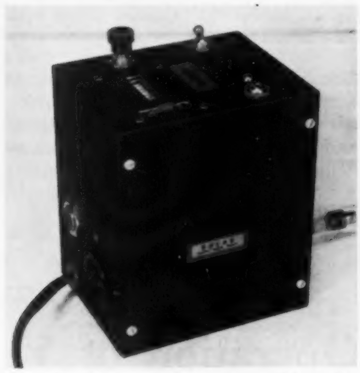


Fig. 8. Roger S-F camera drive for single-frame cameras.

analysis and measurement by projecting them frame by frame vertically upon a drawing board on which charts were made for this purpose.

It may be concluded here that there is a field for further utilization of photography and cinematography as applied to scientific and industrial research and that time-lapse can serve students of medicine, biology, chemistry, engineering and other industrial sciences.

Other Time-Lapse Subjects

We all have seen motion pictures of flowers opening or plants growing. In fact, many subjects lend themselves to interesting time-lapse studies. Such subjects are regularly handled by our laboratory as a matter of routine. For example, the growth of plants may be shown side by side in ordinary soil as compared with plants growing in soil with a fertilizer added. For time-lapse work, such as this, we have designed special apparatus (Fig. 6). Plants need daylight for proper growth, but in order to take color photographs (using Kodachrome), for example, in this case, light of 3200 K is required. Pictures are usually taken at the rate of one or two frames per hour. During the interval the plants are illuminated by a combination of incandescent and daylight fluorescent lamps, but at the moment of exposure

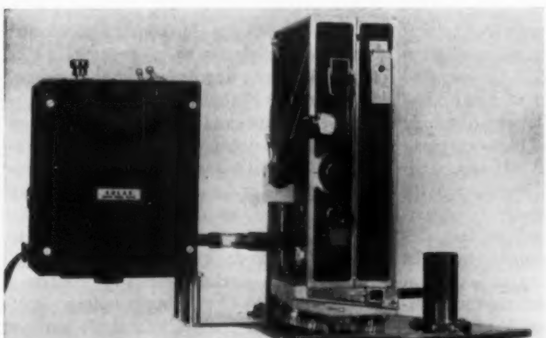


Fig. 9. Light outlet of Roger S-F camera drive is used for automatic turning on of light source.

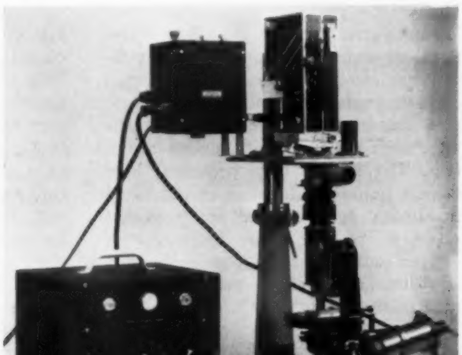


Fig. 10. Same camera drive as shown in Fig. 8 set up for time-lapse, controlled by Roger Camera Timer "I."

Fig. 11. Model "M" Camera Timer with built-in camera motor.

these lights go off while the incandescent lamps for color work go on, after which this process is reversed. The apparatus used for this time-lapse work is manufactured by Rolab.

Various Equipment

One apparatus of importance to us is the Roger Camera Timer "I," which in fact is an intervalometer (Fig. 7). The dial on the left may be turned to 1, 2, 3, 4, 6, or 8 frames/min while the two dials on the right may be turned to 1, 2, 3, 6, 12 or 24 frames/hr.

The center switch has three positions, turned to the left the minute device is operating, turned to the right the hour device is operating and in the center position the current is off. Colored pilot lights indicate when minute or hour devices are "on." There are *two* outlets for operating *two* Roger S-F camera drives for single-frame cameras (Fig. 8). These camera drives turn the camera over one single frame every time upon receiving a signal from the Camera Timer. The light outlet is used either to connect with the incandescent light source, which automatically is turned on when the shutter in the camera is open (Fig. 9), or to operate a relay to control more powerful lights or to operate light sources intermittently as has been explained in timelapse photography on plant growth where two different light sources are required. One or two of these S-F camera drives may be used from one Camera Timer; however, it is possible to operate any number of cameras by the addition of more outlets to the Camera Timer (tripping devices).

Rolab Photo-Science Laboratories have long produced another Camera Timer now called model "M" which has the camera motor built in as an integral part of its mechanism (Fig. 11). This instrument has been furnished to many research laboratories, here and abroad, for approximately 25 years. The construction of these instruments has been so reliable that some of the original instruments are still in operation after 25 years of service.

Edit. Note: At the Convention a motion picture was projected to illustrate many of the techniques and procedures of time-lapse cinematography.

Note: The Author and Editor regret that it has thus far been impossible to prepare a more extensive presentation complete with literature references and more tutorial material.

Operation of Vidicons in Unusual Environmental Conditions

By G. A. ROBINSON

The influence of unusual environmental conditions on the performance of commercially available vidicons is reported. It is found that increasing the faceplate temperature to 90 C does not affect the resolution, increases the dark current and decreases the sensitivity when the dark current is held constant. Data are presented for the durations of application of greater than normal cathode radiation at which image burn is produced. It is found that the envelopes of most commercial types of vidicons do not fail at pressures below 50 atmospheres. The only observed effect of nuclear radiation was the reduction of sensitivity caused by browning of the glass faceplate.

This Note discusses the effect of unusual environmental conditions on vidicon performance. Conditions covered include levels of faceplate temperature and illumination above maximum ratings, high pressure, and nuclear radiation. The limited data presented here do not imply a relaxation of published maximum ratings, but are intended solely to provide some indication of vidicon performance in those specialized applications for which the risk to the tube might be justified.

High-Temperature Operation

Published technical data for most vidicons list a maximum recommended faceplate temperature of less than 75 C. However, some data have been accumulated for a limited sample of typical 7038 vidicons (maximum recommended faceplate temperature of 60 C) operated over a temperature range of from 30 to 90 C. These data, which were obtained only during short-term high-temperature excursions lasting 30 minutes, indicate that dark current increases with increasing temperature, and vidicon sensitivity at a constant dark current decrease with increasing temperature. In general, no permanent changes in vidicon characteristics were caused by the high-temperature operation, and temporary changes were consistent from one excursion to another. Resolution was maintained up to 90 C.

Figure 1 shows curves of relative target voltage for a typical 7038 vidicon as a function of temperature for various dark current. As indicated, 100 on the relative target-voltage scale corresponds to a range of 60 to 100 v for a typical tube. These curves show that target voltage may be decreased to maintain constant dark current as temperature increases.

Figures 2 through 5 give curves of signal-output current as a function of faceplate illumination for selected values of dark current and temperature. These curves show that there is a greater loss of sensitivity per degree change in temperature at the higher temperatures; at low temperatures, a greater loss of sensitivity per degree change in temperature occurs at the lower dark currents.

These data can be applied to the design of camera systems intended for operation over wide ranges of ambient temperature. For example, a camera may be designed to operate automatically over a temperature range of from 30 to 80 C at a dark current of 0.06 μa. Figure 1 shows that for this value of dark current at 30 C the target voltage is 45 to 75 v. To maintain a dark current of 0.06 μa as temperature increases, the camera must be equipped with a temperature-sensitive device which will reduce target voltage in accordance with the curve of Fig. 1 so that at 80 C the target voltage is about 7 to 12 v.

Faceplate illumination must also be

A contribution submitted on March 2, 1961, by G. A. Robinson, Electron Tube Div., Radio Corp. of America, Lancaster, Pa.

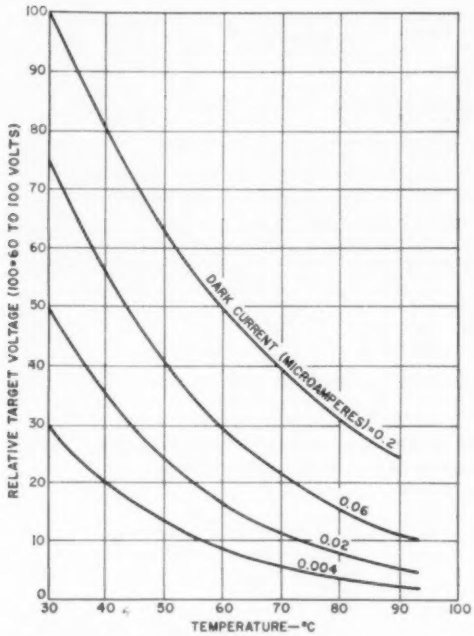


Fig. 1. Variation of target voltage with temperature for several values of dark current for typical 7038 vidicon.

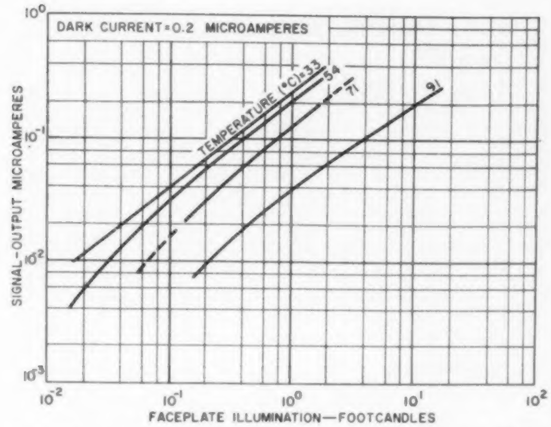


Fig. 2. Variation of signal-output current as a function of faceplate illumination at a dark current of 0.2 μa.

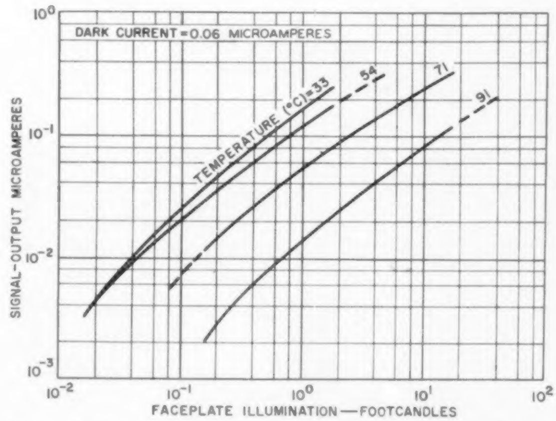


Fig. 3. Variation of signal-output current as a function of faceplate illumination at a dark current of 0.06 μa.

increased with increasing temperature to provide a constant signal-output current. Figure 3 shows that at a dark current of 0.06 μa, the faceplate illumination must be increased from 1 ft-c at approximately 30 C to 20 ft-c at 80 C to maintain a constant signal-output current of 0.2 μa. This increased faceplate illumination might be provided by an automatic temperature-sensitive iris control.

Image Burn at High Light Levels

Image burn in vidicons has been investigated to determine what levels of illumination can be applied to the faceplate of a vidicon before permanent burns result.

Intensity of image burn is not reduced by removal of the near-infrared or ultraviolet energy from the source. Moreover, image burn is not a function of the electric field or current flow across the photoconductive layer.

High values of illumination were obtained by focusing an image of the sun onto the faceplate of the vidicon by means of a lens. The illumination level was varied by use of different lens stop openings and, in some cases, by the use of neutral density filters. Table I lists the effect of excessive faceplate illumination for various exposure times.

Resistance to High Pressure

Vidicons were placed separately into a small pressure chamber. Nitrogen gas under high pressure was leaked into the chamber by means of a regulator valve. The gas pressure was increased until the vidicon imploded, at which time the pressure was recorded. Table II lists the results of the high-pressure testing for a limited number of vidicon types.

The tubes were not held under pressure for any length of time; in all cases, the pressure test for each vidicon was performed in less than 10 minutes. Moreover, the tubes were not subjected to any shock or vibration while in the chamber. These conditions should be considered for field applications involving high pressures.

Effect of Nuclear Radiation on Spectral Sensitivity

A type 6198 vidicon was exposed to a total radiation dosage of 10^{15} neutrons/sq cm. The spectral response of the photoconductive layer was unchanged by irradiation; however, the total measured output-signal current was reduced by ap-

Table I. Exposure Time for Permanent Burns

Faceplate illumination (ft-c)	Definite	Probable	Possible	Unlikely
33,200,000	1/3 sec	—	—	—
20,700,000	1/2 sec	—	—	—
10,300,000	1 sec	—	—	—
1,890,000	12 sec	3 sec.	—	—
1,170,000	20 sec	5 sec	1 sec	—
619,000	1 min	12 sec	3 sec	—
292,000	3 min	30 sec	5 sec	—
150,000	8 min	1 min	9 sec	—
103,000	15 min	5 min	12 sec	—
37,000	45 min	20 min	1 min	1 sec
18,900	1 1/2 hr	45 min	5 min	2 sec
9600	—	2 hr	15 min	6 sec
9200	—	2 1/2 hr	20 min	8 sec
6190	—	3 hr	30 min	10 sec
2920	—	—	1 hr	20 sec
1890	—	—	2 hr	30 sec

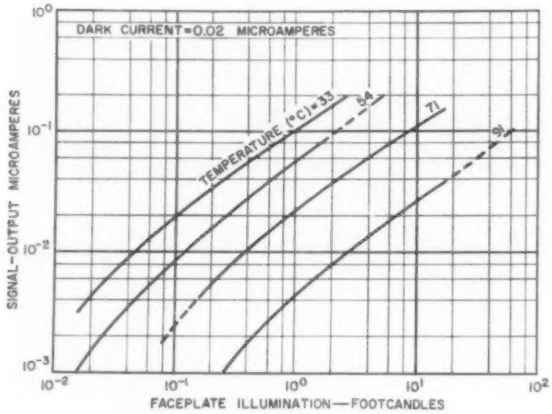


Fig. 4. Variation of signal-output current as a function of faceplate illumination at a dark current of 0.02 μa.

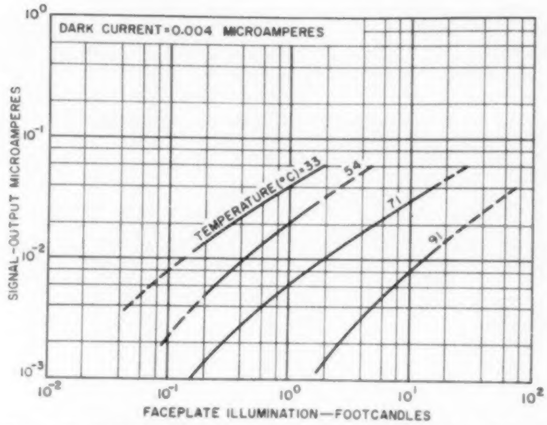


Fig. 5. Variation of signal-output current as a function of faceplate illumination at a dark current of 0.004 μa.

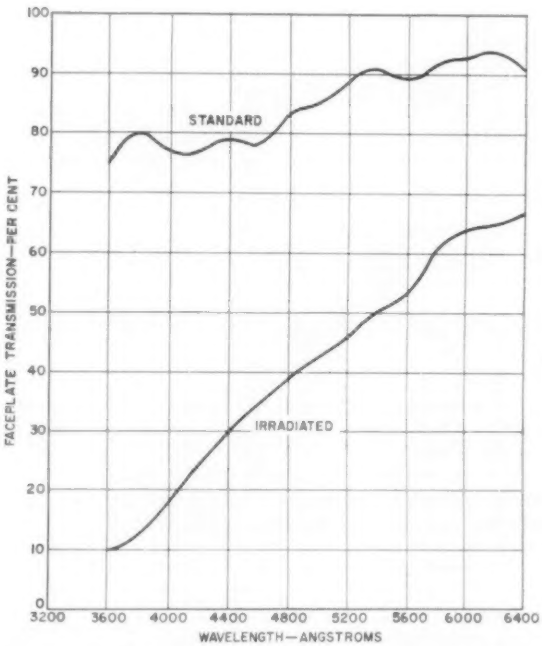


Fig. 6. Transmission of a 6198 vidicon faceplate as a function of wavelength before and after nuclear irradiation.

Table II. Results of High-Pressure Testing of Various Vidicon Types.

RCA Type	Results
Dev. No. C73484 (½-in. type, cold seal)*	Imploded at 530 psi (36 atm)
Dev. No. C73475 (½-in. type, rf seal)	Did not implode, but faceplate fractured at 950 psi (65 atm)
7038 (1-in. type, cold seal)†	Imploded at 850 psi (58 atm)
7038 (1-in. type, cold seal)†	Imploded at 700 psi (48 atm)
7038 (1-in. type, cold seal)†	Imploded at 680 psi (46 atm)
6326 (1-inch type, rf seal)	Sound at 950 psi (65 atm)
6326 (1-inch type, rf seal)	Sound at 950 psi (65 atm)
6326 (1-inch type, rf seal)	Sound at 1150 psi (78 atm)

* Also would apply to type Dev. No. C74053.

† Results for this type should apply also to types 7262-A, 7263-A, 7735-A, 7697, and 2048-A — all having 1-in. cold seals.

proximately 34%, and the blue sensitivity of the vidicon was reduced as a result of discoloration or browning of the faceplate.

The transmission of the irradiated faceplate coated with a transparent conductive layer measured with a Weston photronic cell was 60% as compared with 92% for a nonirradiated transparent-conductive-layer-coated faceplate similarly measured. The 35% reduction in transmission caused by radiation browning substantially agrees with the total output-signal current drop.

Theoretical output-signal current I_s for a vidicon is calculated by use of the following equation:

$$I_s = (K\int_0^\infty E_\lambda T_\lambda S_\lambda d\lambda)^\gamma$$

where:

E_λ is the power per unit of wavelength at wavelength λ of a 2870 K tungsten source,

T_λ is the spectral transmittance at wavelength λ of the transparent faceplate,

S_λ is the sensitivity at wavelength λ of the photosurface (in amp/w),

γ is the gamma value of the vidicon, and

K is a constant.

The drop in output-signal current is determined by the ratio of the output-signal current for a normal vidicon and an irradiated vidicon. The expressions were integrated for wavelengths between 3600 and 6400 A; values for T_λ are given in Fig. 6.

$$\frac{I_{s2}}{I_{s1}} = \left(\frac{495.7}{892.6}\right)^{0.65} = 0.68, \text{ or a 32\% drop in signal-output current.}$$

These correlating values show that the loss in signal from the irradiated tube was entirely caused by faceplate browning and not by decreased sensitivity of the photosurface.

Automatic 35mm Motion-Picture Printer

By EDWARD P. KENNEDY, JOSEPH L. DeCLERK and DOMENIC L. LaBANCA

Auxiliary equipment has been designed and built in an experimental form which will automatically control the light shutter of a Bell & Howell printer. By means of silicon solar cells, a contact-making voltmeter and a 22-step selsyn transmitter device the aperture control of the printer is varied in accordance with the opacity of the negative being printed.

Introduction

This paper describes an Automatic 35mm Motion-Picture Printer employing electromechanical principles to print uniform density positives from negatives which have varying opacity. Automatic printing of 35mm film will accelerate the printing and processing, and substantially lower the cost of these operations.

The automatic features have been incorporated into an existing motion-picture printer. The normal procedure for operating the printer, before the modification, was for an operator to view the scene and then to set manually an exposure control (iris) to a compensating *f* (iris stop) number. This was usually slow and required full time attention.

The automatic features of the system consist of the following (System Diagram, Fig. 1):

(1) an opacity sensing circuit and amplifier,
(2) a contact making voltmeter,
(3) a nonlinear 22-position mechanical scanner, and
(4) a selsyn transmitter and receiver.

The overall view of the experimental system connected to the Model D Bell & Howell printer is shown in Fig. 2.

The opacity sensing sub-system includes an exciter lamp, a silicon solar photocell, a d-c amplifier and a differential amplifier. The amount of light from the exciter lamp is of constant brightness; therefore, the intervening degree of opacity of the film emulsion to be sampled controls the amount of light passing through the film and reaching the photocell. The output of the photocell is proportional to the light reaching its input.

$$E \alpha B$$

where E = output of photocell
B = brightness of lamp
letting γ = opacity of the film
K = constant of proportionality
then $E = KB\gamma$

The output of the silicon photocell is amplified by a d-c amplifier and sensed in a differential amplifier driving a contact-making voltmeter. The voltmeter indicator, during the sampling cycle, is free to swing and assumes an angular position which is directly related to the output voltage of the photocell. Behind the free end of the meter indicator or cursor, and in the same location as is normally occupied by the voltmeter readout scale, a segmented series of 22 mutually insulated segments is located. The 22 varying size segments are directly related to the *f* numbers on the printer.

After the cursor has been energized by the sampling voltage, the cursor is clamped and depressed against the evaluated *f* number segment. This makes an electrical connection which places a voltage on a remote, complementary segment which is part of the mechanical scanner. The mechanical scanner is

A contribution by Edward P. Kennedy (deceased), Joseph L. DeClerk and Domenic L. LaBanca, U.S. Army Signal Research and Development Laboratory, Fort Monmouth, N.J.
(This paper was first received on December 22, 1960, and in final form on March 6, 1961.)

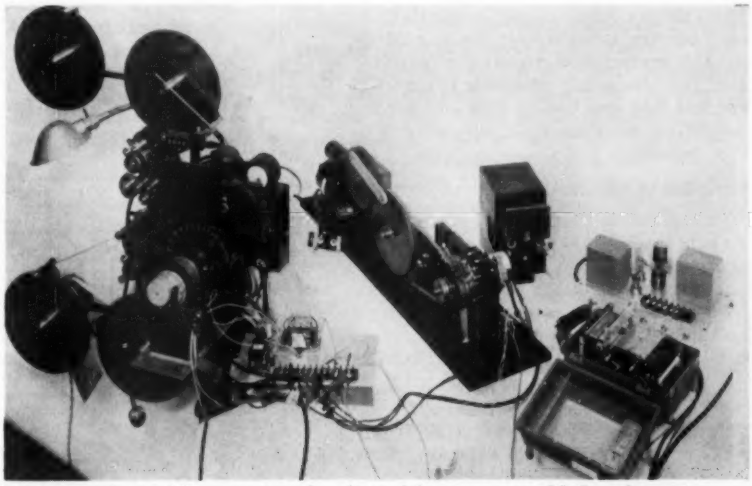
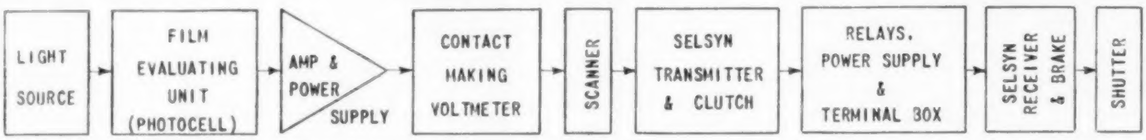


Fig. 2. Experimental 35mm automatic printer, laboratory assembled equipment.



Silicon solar photocell looks at film passing by. Different densities produce different voltages, which will by control circuits produce different settings on the printers shutter arm.

Amplifies voltage from photocell so that it can be sampled on the contact making voltmeter (C.-M.V.). Supplies power for light source.

Samples different voltages and makes contact on a printed circuit segment which acts like closing a switch. When closed this switch energizes a relay which operates the clutch and brake. When this happens the machine is ready to print in the normal manner.

Each segment on contact making voltmeter is connected to a similar segment on the selsyn transmitter. This transmitter is constantly moving a contact arm across an arc of insulated segments. When the contact making voltmeter switch closes, this clutch keeps the contact arm on one insulated segment, at the same position as the contact making segment on the voltmeter.

Supplies power to solenoid operated brake. Houses relays which operates clutch and brake.

Each position on printer face plate, numbered 1–22 corresponds to similar insulated segments on transmitter and contact making voltmeter. When C.M.V. switch operates clutch and brake the printer arm stops at the correct shutter number and printer is ready to print in the normal manner.

Fig. 1. Block diagram of 35mm automatic printer.

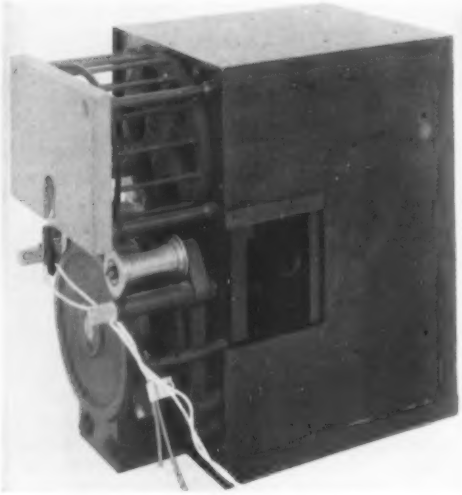


Fig. 3. Light evaluating unit.

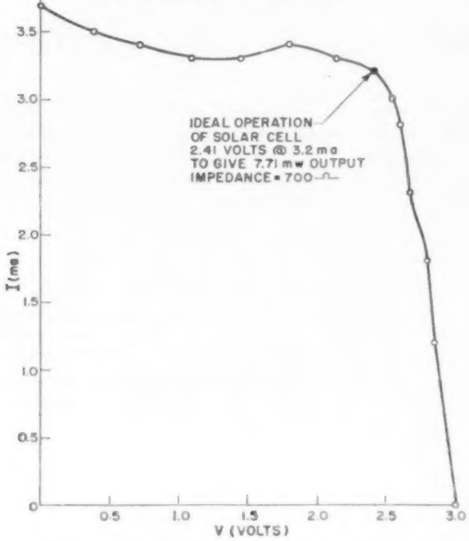


Fig. 4. V vs I curve of solar cell; 1 amp, 6-v a-c placed above solar cells.

driven by a motor and is constantly searching the 22 segments for a signal. Upon the detection of a signal, the scanner locks to the signal emitting segment which represents the correct exposure for the sampled film. The angular position of the scanner arm is transmitted by a selsyn transmitter to a selsyn receiver which positions the printer's shutter opening to the correct stop number. The scanner arm remains in the locked position for the remainder of the scene and then goes back to its scanning mode for the detection of the next scene f-stop number.

Description of Apparatus

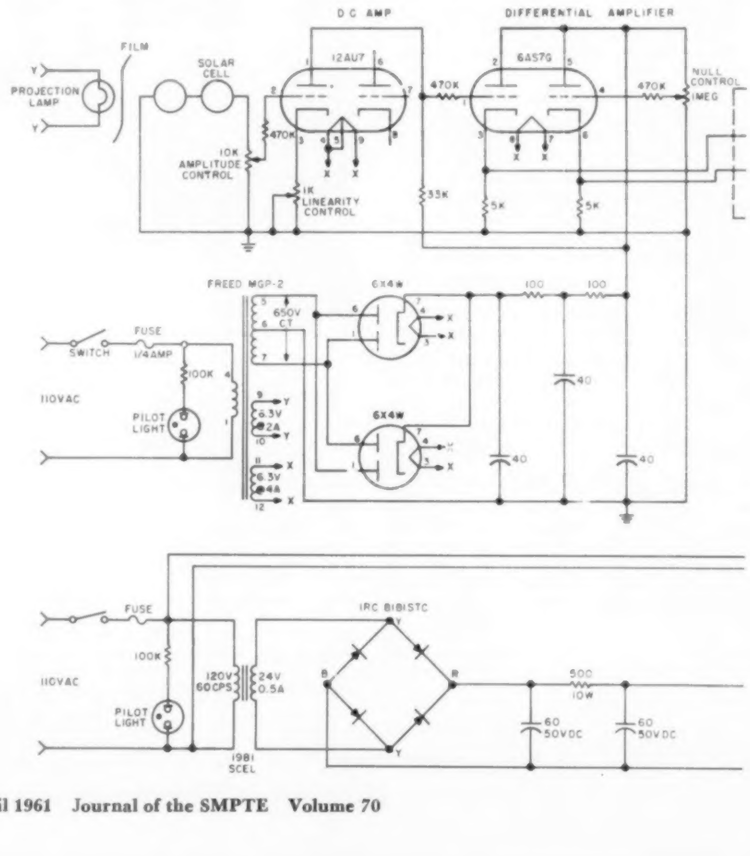
Solar Cell Sensing Unit: Six silicon solar cells were machined to fill out the standard 35mm sound film frame (Fig. 3). The effective size of the 35mm frame as taken from the American Standard PH 22.59–1954 is 0.631 in. by 0.868 in. To fill this entire area, six silicon cells 0.187 in. × 0.631 in. were placed together with a 0.045-in. overlap. This combination of solar cells was placed behind the film frame.

A test was run to determine the optimum operation of the silicon solar cells in the printer. A 1-amp, 6-v, a-c tungsten filament lamp was placed 1 in. above the array of solar cells. The ideal loading of the cell occurred for an impedance of 700 ohms yielding a power output of 7.71 mw. A curve showing this relation appears in Fig. 4.

D-C Amplifier and Differential Amplifier: The output of the solar cells is amplified through a d-c amplifier. The output of the d-c amplifier is sampled through a differential amplifier by a contact-making voltmeter. The differential amplifier is nulled with the light source ON and a blank runner in the film gate. The contact-making voltmeter samples the voltage across the cathodes of the differential amplifier.

Contact-Making Voltmeter: A recording type of voltmeter, such as the General Electric CF-1 (Fig. 5), was modified as follows. A printed circuit consisting of 22 mutually insulated segments was made to replace the contact bar. This was situated where a calibrated scale normally appears in a conventional voltmeter. The areas of the segments are proportional to the f-stop numbers. As the needle assumes its position as a result of the voltage impressed, it is clamped to the desired segment and establishes an electrical contact.

Mechanical Scanner and Selsyn Transmitter (Fig. 6): A 22 position, motor-driven scanner searches for a closed circuit which has been established by the contact-making voltmeter. When the closed circuit is found, a clutch disengages the motor drive and the contact arm comes



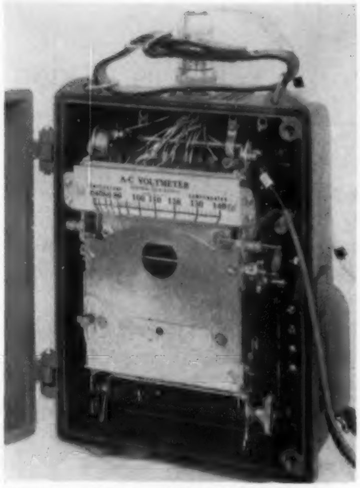


Fig. 5. Contact making voltmeter.

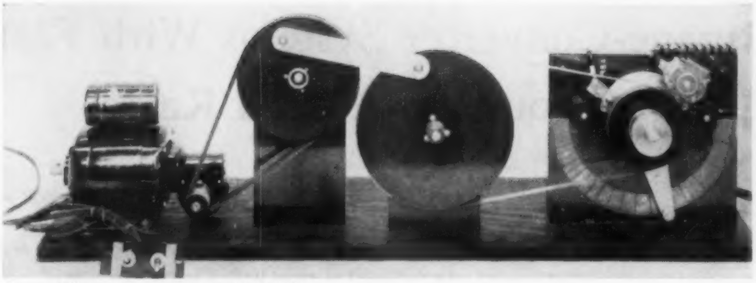


Fig. 6. Selsyn transmitter and clutch.

to rest. The position of the arm is transmitted by a selsyn transmitter to a selsyn receiver which is mechanically coupled to the *f*-stop position arm on the 35mm printer. In the mechanical linkage, an electromagnetic brake is actuated to keep the correct stop number until the scene is printed. A schematic diagram of the complete system is shown as Fig. 7.

Operation Procedure

Before placing the negative to be printed into the machine, a definite procedure must be followed. The scenes must be separated by sufficient film to allow detection of opacity by the photocell, and automatic setting of exposure, before the scene reaches the printing station. A notch in the film activates a switch which operates the two-second time delay multivibrator which, in turn, operates the momentary switch shown in Fig. 7. The closing of the momentary switch activates the sensing unit, and selection of the proper exposure is made. The exposure is maintained until the next film notch passes by the momentary switch, indicating a new scene. The time delay multivibrator is again energized, and recycles the selection procedure. The sequence of operation is as follows.

(1) Splice all negative scenes into a reel head first, allowing a 2-ft blank leader to separate the scenes and a 12-ft length of blank leader for threading.

(2) Notch film edge at proper location relative to the start of each scene to be printed.

(3) Thread leader through opacity sensing apparatus, then thread the same leader through the printing machine as usual. (It is assumed that the printing machine light source is in readiness and that the printing machine power motor is running.)

(4) Place machine starting lever in the OPERATE position. The film edge notch approaches the emulsion evaluation apparatus.

(5) When film edge notch operates the first switch, the opacity sensing components and the scanner mechanism become activated.

(6) The contact-making voltmeter cursor assumes an angular position which represents voltage displacement in terms of opacity of the negative. The cursor stops and holds its position in front of a certain contact-making voltmeter segment.

(7) At the same time, the motor-driven scanning arm is searching the faceplate for (a) a contact which will close a clamping device which will press the meter cursor against the contact behind it; (b) a contact which will energize the selsyn motor system.

(8) When contacts are made, the scanning arm stops. The electrical segments on both the contact-making voltmeter and the faceplate are electrically interconnected so that they are, in effect, in series.

(9) The brake holding the shutter is activated when the contact-making voltmeter completes the circuit.

(10) The shutter stays in this position until the scene is printed and until the film notch at the beginning of the next scene activates the switch — thus recycling the selection mechanism.

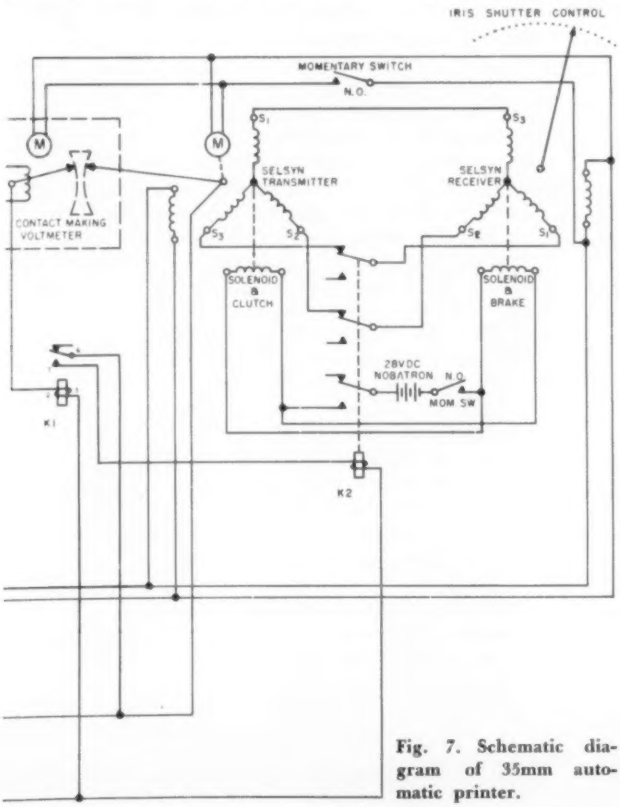


Fig. 7. Schematic diagram of 35mm automatic printer.

Conclusions

The experimental breadboard system for automatizing 35mm printing was done with no attempt at reducing the size of the auxiliary equipment. Transistors could be used to advantage as could also printed circuit techniques. This unit points the way. The next step is to engineer the experimental version in accordance with good commercial practice.

Image-Converter Systems With Fast Image Group Repetition Rates

By ROBERT W. KING
and JOHN H. HETT

Three different types of image-converter cameras have been designed over the past several years with various characteristics but all emphasizing fast exposure rates. The three cameras all use the Mullard converter tube type 1201 with the short-persistence blue phosphor for photographic recording. The first camera produces a sequence of six rectangular images having an aspect ratio of about 5:1. The exposure time of 0.4 μsec was used and a fixed exposure interval of 5 μsec. This camera takes one group of six exposures at a time with a relatively long recovery time.

The second camera has considerably advanced characteristics. This camera makes six exposures on a single frame at rates varying from 2×10^6 to 2×10^4 exposures/sec. The frame rate extends from zero to 5000, the upper limit depending on exposure rates. Exposure durations have these values: 0.1, 0.3, 1.0, 3.0 and 10.0 μsec. Repetition-rate and exposure-time duty cycle may not exceed 20%. Deflection of the image takes place on both axes, producing two rows of three exposures.

The third and latest camera design is similar to the second, having exposures of 0.1, 0.3, 1.0, 3.0 and 10 μsec and corresponding exposure rates of 2×10^6 to 2×10^4 exposures/sec. The sequence of pulse and shutter pulse generator is very similar; however, the sweep is wholly on one axis and therefore similar to that of the first camera described. The mechanism of sweep generation is quite different, however, the basic sweep form being generated by a diode-pump counting circuit. Displays of 4 or 8 images may be selected.

Three different types of image-converter cameras have been designed over the past several years having various characteristics but emphasizing fast exposure rates. The three cameras all use the Mullard converter tube type 1201, usually with the shortest persistence blue phosphor for photographic recording.

The Mullard 1201 image-converter tube uses electrostatic and electromagnetic focusing and electromagnetic deflection. The tube has a conical-cylindrical electrode, called the grid, mounted axially between the photosensitive cathode and the fluorescent screen. In operation there are a variety of grid potentials relative to the cathode that will produce a focused image in conjunction with a suitable axial magnetic field. Use of these different operating points results in different values of image magnification between cathode and screen. The useful range of linear magnification is between 1 and 4½. To deflect image across the screen, a magnification of about 3½ is used and the cathode image area is correspondingly restricted. This is the least magnification one is able to use and avoid cutting off the deflected image by the grid structure.

Earliest "Framing" Image-Converter Camera

The first camera design produced a sequence of six rectangular images having an aspect ratio of about 5:1. These were displayed one above the other on the screen and photographed by a single-frame camera. This display requires image deflection in one axis only. The sweep circuit was designed around the deflection coil as a resonant circuit which established the exposure repetition rate for the camera. Exposures were required at intervals of 5 μsec, resulting in a resonant frequency of the deflection coil circuit of 200 kc.

The coil is resonated with a parallel capacitor at its required frequency. When the camera is tripped the coil circuit is shock excited by discharging a large capacitor into it by firing a thyratron. The resulting current and voltage waveform are shown in Fig. 1. The voltage waveform is unipolar, resulting in an increase in coil current with every cycle. This produces a current staircase waveform which will give the desired deflection sequence, since the image position is directly proportional to the coil current. The initial position of the image is biased to one side of the screen by small permanent magnets.

Several circuit features may be of interest. First, a feedback circuit is required to supply the deflection circuit losses because otherwise the voltage and current waveform will damp out too quickly. It should be noted that a small triode is sufficient in spite of the deflection coil current of 2.5 amp/step. Second, a switch triode is required to gate the first so that the circuit will remain quiescent until fired, otherwise the circuit may break into oscillation at any time since it has no net losses.

A third item of interest is the diode placed across the deflection coil circuit, poled in such a way as to conduct

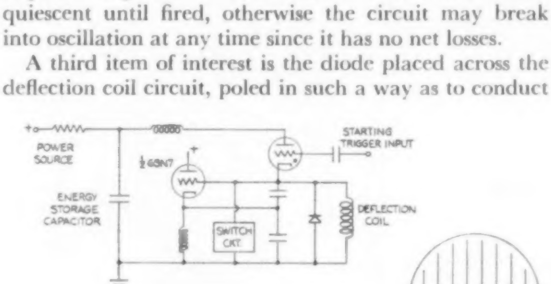


Fig. 1. Sweep circuit giving current and voltage pattern across the deflection coil.

Presented on October 18, 1960, at the Fifth International Congress on High-Speed Photography in Washington, D.C., by Robert W. King and John H. Hett (who read the paper), Hett Associates, Inc., Cresskill, N.J.

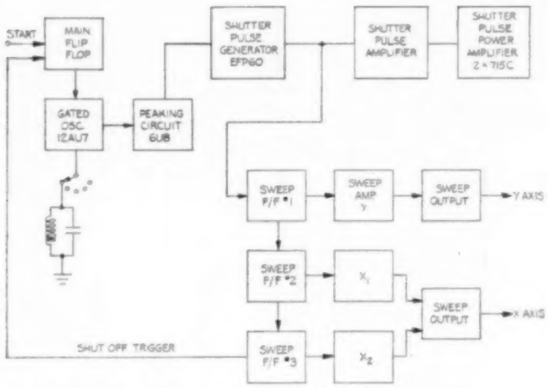


Fig. 2. Block diagram of improved framing image-converter camera.

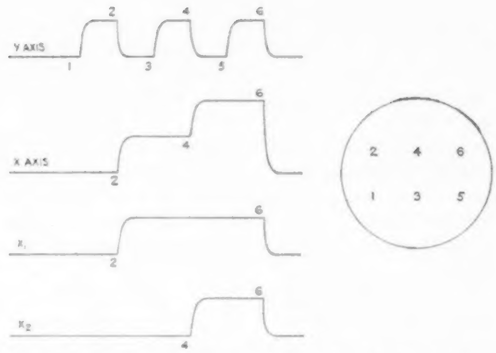


Fig. 3. Sweep current waveforms for six-image rectangular array.

if the coil voltage attempts to reverse. When conducting, the diode effectively short circuits the coil and holds the coil current constant briefly while the exposure is made. The diode makes adjustment of the feedback in the deflection circuit completely noncritical since any excess is clipped off.

The shutter pulses are triggered off by a circuit driven by the deflection coil voltage. A phase shifter is provided to allow adjustment of the shutter pulses to coincide with the constant portions of the deflection current steps. The shutter pulse generating circuit is a conventional hard tube modulator producing 3-kv flat-topped pulses of 0.4-μsec duration which are applied to the image-converter-tube cathode. The grid is grounded and the anode is operated at $+3$ kv.

No attempt is made to stop the circuits when the required number of exposures has been made. The deflection circuit simply carries the image off the screen and the oscillations die out before it returns. The number of images produced is determined by the initial voltage to which the energy storage capacitor is charged.

All the power supplies have very low current capabilities since they simply charge capacitors which supply all the energy during the exposure sequence.

An Improved "Framing" Image-Converter Camera

The second image-converter camera has considerably advanced characteristics. This camera makes six exposures on a single frame at rates varying from 2×10^6 to 2×10^4 exposures/sec. Exposure durations have the following values: 0.1, 0.3, 1.0, 3.0 and 10.0 μsec. Repetition rate and exposure duration are independently variable within the limitation that the exposure duty cycle may not exceed 20%. Deflection of the image takes place on both axes, producing two rows of three exposures. Additional modes of operation provide for a single undeflected exposure per input trigger at rates up to 2×10^4/sec, and a linear sweep along the y-axis with a total sweep-duration range from 2 to 400 μsec.

In the framing mode the basic pulse sequence is established by a ringing oscillator started by an input trigger as shown in Fig. 2. The oscillator contains five tuned circuits, one of which is selected to give the desired repetition rate. The oscillator output is converted to triggers which are used to trigger the shutter pulse generator and the sweep generator.

The shutter pulses are produced by an EFP60 secondary emission pentode using plate-to-cathode feedback. The three shorter exposure pulse lengths are established by current-fed lumped-constant delay lines in the plate circuit. The two longer exposure pulses are controlled by RC feedback. The positive pulse output is taken from the dynode and further amplified in a 715 tetrode cathode output amplifier. It is then fed to a pair of 715C power amplifiers. The output pulse at 6-kv amplitude is directly coupled to the cathode of the image-converter tube. The grid and screen are tied together and connected to the anode supply.

By tying the grid to the screen at the image-converter tube, we were able to obtain substantially less distortion than in the first converter which operated the grid at an intermediate potential. This distortion took the form of a rotation of the very bright portions of the image relative to the less intense regions. The power required to generate the larger shutter pulse is four times greater, but the improvement in image quality justifies this.

To provide sufficiently fast rise and fall times for the shutter pulse at 0.1-μsec duration requires a load resistance for the power amplifier of 200 ohms. The 6-kv pulse is produced by drawing 30 amp through the load resistance. At the longer exposure times the plate current may be reduced by using larger load resistances, resulting in an increase in rise time. The point of doing this is to allow the pulse amplifier to operate at higher pulse repetition rates without exceeding the power dissipation rating of the circuit. The screen voltage on the power amplifier is reduced as the load resistance is increased to reduce screen dissipation. The anode supply voltage must also be adjusted to produce exactly a 6-kv pulse to give a correctly focused image. The grid drive can be left the same under these conditions, which simplifies the driving circuitry. The pulse generating circuitry has the capability of generating groups of six 0.1-μsec shutter pulses at a group repetition rate of 5000/sec.

The sweep waveforms for this system are shown in Fig. 3 and produce the image sequence shown. The basic waveforms are generated by three Eccles-Jordan flip-flops triggered by the shutter pulses. The logic between the flip-flops produces the required waveforms which are amplified by EFP60's and fed to 715 tetrodes which drive the deflection coils.

The y-axis deflection coils are connected to a switch which places them in parallel for the high repetition rate

and switches them to series for the slower rates. This arrangement is used to get the highest possible self-resonant frequency in the coils since this limits the speed with which the current can be changed from one value to another.

The deflection coils for this camera were wound on the legs of a rectangular ferrite core built up of ferrite slabs. This coil is vastly easier to build than the distributed winding coil used on the first converter and produces deflections with apparently negligible image distortion.

Initial image positioning is obtained by a set of offset coils wound on a similar rectangular coil form whose core is made of soft iron. The coils are driven by two low-voltage rectifiers. Undistorted deflection of the image can be obtained to any part of the screen.

The linear sweep circuit for this converter is required to generate sweeps of 2–400-μsecs duration in approximately logarithmic sequence. Various attempts to do this with capacitors discharging through a thyratron directly into the deflection coil were unsuccessful. Therefore an amplified sweep was tried and successfully developed.

The linear sweep generator is shown in Fig. 4. The starting trigger sets the main flip-flop which cuts off the gate tube, allowing the voltage to build up on the sweep capacitor.

The exponential voltage rise is fed through the cathode follower to the sweep power amplifier — the same tubes used on the y-axis in the sequential mode. The waveform shows a step at the beginning of the sweep. This is produced by the resistor in series with the sweep capacitor and is used to bring the 715 tubes from cutoff into the region having appreciable transconductance. This avoids serious nonlinearities at the beginning of the sweep. Further linearization of the sweep is achieved by using the exponential shape of the voltage rise to counterbalance the plate current vs. grid voltage curve of the 715's which increases in slope as the grid voltage approaches zero. The amount of curvature required in the voltage waveforms can be controlled by choice of the charging voltage in relation to the grid swing on the tubes. In this circuit we have used about one third of the total rise.

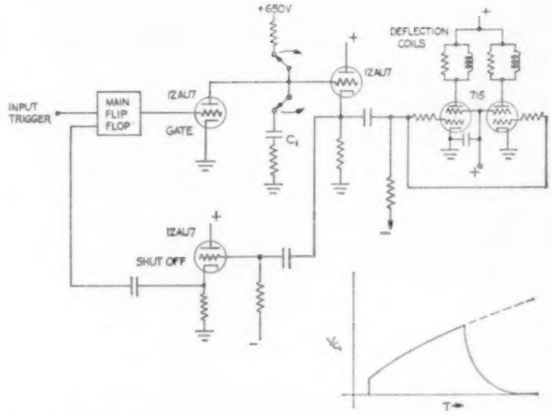


Fig. 4. Linear sweep generator for 2–400-μsec duration.

The triode in the lower left section of Fig. 4 labeled "shut off" is biased with the same voltage that appears on the 715 grids. When the sweep waveform drives it up into conduction, the output across the cathode resistor is used to shut off the main flip-flop and terminate the sweep. Thus all sweeps from 2 μsec to 400 μsec have the same length on the IC tube screen.

Latest Image-Converter Camera

The third and latest camera design is similar to the second, having exposures of 0.1, 0.3, 1.0, 3.0 and 10.0 μ sec and corresponding exposure rates from 2×10^6 to 2

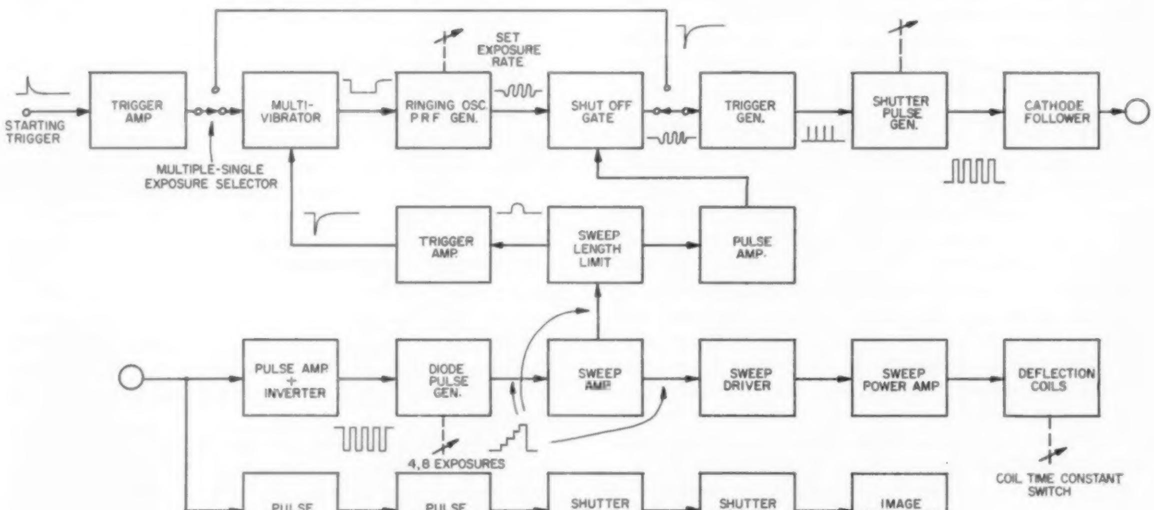


Fig. 5. Block diagram of latest image-converter camera showing waveforms at each step.

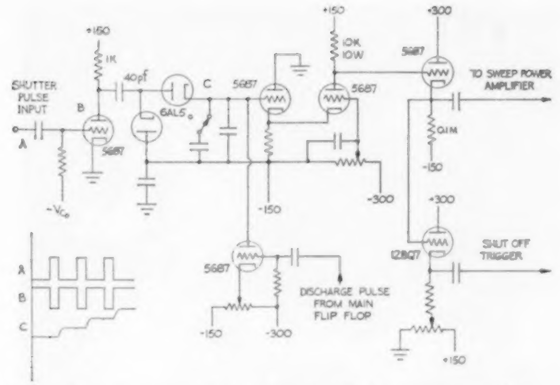


Fig. 6. Sweep generator circuit using diode-pump counting.

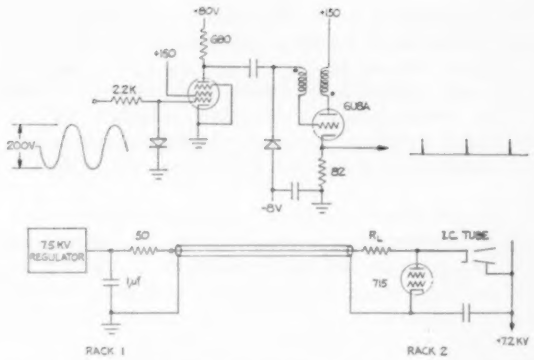


Fig. 7. Above: trigger generator; below: power supply coupling.

$\times\ 10^4$ exposures/sec. The sequence of pulse and shutter pulse is very similar. The sweep, however, is on only one axis and therefore is similar in appearance to that of the first camera described. The mechanism of sweep generation is different, however, since a high exposure repetition rate is required. The block diagram of this system is shown in Fig. 5. The sweep generator circuit is shown in Fig. 6.

The shutter pulses at low level are taken from the EFP60 generator and are put into a diode-pump counting circuit. The shutter pulse charges the input capacitor and the trailing edge dumps the charge into the accumulating capacitor where it produces a step rise in voltage. A cathode-driven sweep amplifier feeds a cathode follower driving the sweep power amplifier tubes and deflection coil, which are the same as in the second camera described above. A biased triode connected to the amplifier sweep voltage wave generates a pulse on the final step of the sweep and shuts off the sequence pulse generator, thus ending the cycle. This pulse also discharges the accumulating capacitor in the sweep generator. The number of exposures made on a single frame may readily be varied by changing the size of the accumulating capacitor. Any selected number of exposures will fill the same area of the screen, as determined by the bias on the shut-off diode.

The diode-pump circuit produces the output voltage staircase waveform independent of the shutter pulse width since the input capacitor can be readily charged by the 0.1-μsec pulse. Since the charge is always dumped on the trailing edge of the shutter pulse, relative timing of the sweep motion and exposure is correctly maintained for all pulse durations.

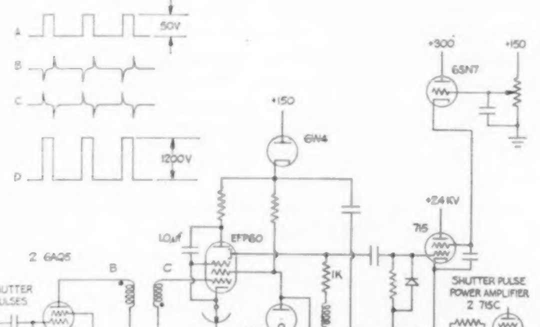


Fig. 8. Bootstrap pulse amplifier.

Several circuit features common to the second and third cameras are of some interest. The first to be described allows one to separate the power supplies from the converter tube chassis without requiring very large voltage capacitors for energy storage in the camera chassis. Figure 7 shows the power supply coupling and the trigger generator.

The anode supply for the shutter pulse power amplifier is connected to the amplifier load resistance through a 50-ohm coaxial cable. The cable is terminated at the power supply by a 50-ohm noninductive resistor in series with the storage or filter capacitor. The power amplifier looking back into the cable to the power supply sees a 50-ohm resistance source which can be put in series with the anode load resistance of the power amplifier and form a part of it. Thus no storage or by-pass capacitor on the anode supply is required in the camera box in spite of the 30-amp pulsed load current.

The trigger generator circuit converts the sine-wave output of the ringing oscillator into sharp triggers to be used to start the EFP60 pulse generator over a frequency range of 100 : 1. The sine wave at a frequency between 20 kc/sec and 2 Mc/sec is fed into a pentode. The series resistors and shunt diode provide sharp clipping of the positive half of the input. Cutoff of the plate current provides negative clipping. The small plate load resistor and low plate voltage limits the plate voltage swing to about 10 v.

The plate is capacitively coupled to the grid circuit of a blocking oscillator, which produces pulses of 0.1-μsec duration. The negative swing at the input causes a rise in plate voltage which triggers the blocking oscillator. After one pulse the oscillator remains cut off by the -8-v bias. The diode in the grid of the 6U8A removes the charge on the coupling capacitor accumulated during the pulse and makes the circuit immediately available for retriggering.

By limiting the amplitude of the pentode plate voltage swing to just slightly more than the triggering voltage required by the blocking oscillator, we ensure that only one output pulse is produced for each input excursion. The blocking oscillator output is taken across an 82-ohm resistor in the cathode circuit where it is reasonably isolated from the rest of the circuit.

The final circuit to be described is a bootstrap pulse amplifier and driver for the shutter pulse power amplifier. This circuit, shown in Fig. 8, accepts input pulses of the correct duration at about 50-v amplitude and provides output pulses to the power amplifier grids at 1200 v and 1 amp of grid current. It does this over a pulse width range of 4000 : 1 with a minimum of switching.

The input pulses (*A*) are fed to a current drive with a pulse transformer in the plate circuit. The pulses are differentiated, inverted and coupled to the grid of an EFP60. The first trigger is positive and turns on the EFP60. Feedback on the EFP60 immediately causes it to saturate itself and generate an output. The second trigger is negative and shuts off the EFP60, thus terminating the output pulse. The feedback constants are designed to provide an inherent pulse width always greater than the input. At the same time the EFP60 must be nearly ready to shut off or the negative trigger may fail to stop it. This conflict accounts for the switching of cathode resistors required to cover the total range of pulse widths from 0.1 to 400 μsec. By providing sufficiently large input triggers, the switching requirements are reduced. With the circuit shown, five values of cathode resistance were provided for reliability, although the circuit would work with three values. The output pulse is coupled by a 715 tetrode connected as a cathode output amplifier to avoid inverting the signal. The entire EFP60 circuit is connected to the 715 cathode so that it rises and falls with the output pulses.

The functions of the pulse transformer now are clear. It must isolate the circuit from ground while coupling in the trigger, and it must differentiate and invert input current pulse. This is much more easily accomplished than designing a pulse transformer to cover a 4000 : 1 pulse width range.

The plate supply voltage for the EFP60 is supplied through the 6W4 diode and stored in the 20-μf capacitor. When the circuit rises during a pulse the 6W4 cuts off and isolates it from the power supply.

A similar problem exists in the screen circuit of the 715 which is tied to the cathode by the capacitor. Here a 6SN7 was used to provide the switching action and simultaneously to provide cathode follower low-impedance output to recharge the screen capacitor rapidly at the end of the pulse. It also provides a convenient means of adjusting the screen voltage with a small variable resistor in the grid circuit.

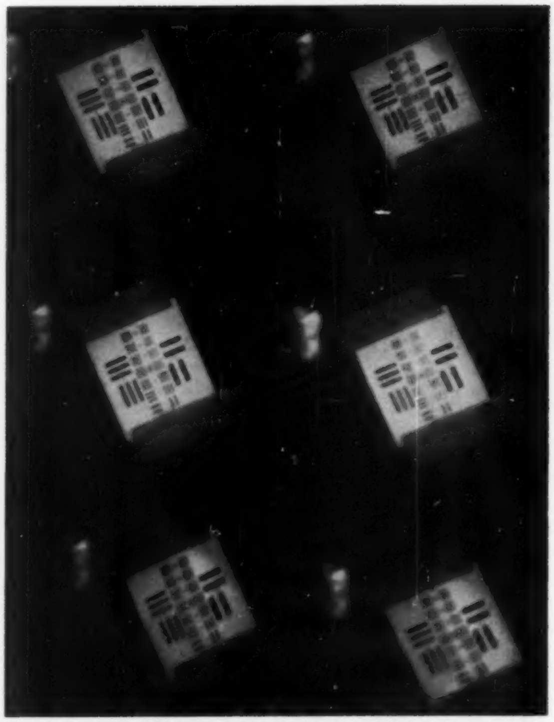


Fig. 9. Sequential pictures taken by Improved Framing Camera.

The load resistance in the cathode of the 715 driver is also switched to economize on plate current during the longer pulses, thus reducing the power dissipation per pulse and allowing a higher power repetition frequency.

Figure 9 shows test pictures taken, by light reflected from the test chart, with the Improved Framing Camera. The illumination was by a Sylvania R4330 lamp. The exposures were 3 μsec and the interval 12 μsec. The first lens was a Cooke 2 in., $f/2$ operated at an object distance of 52 in. so that the charts read directly in lines per millimeter resolution at the cathode. A Leica camera with a 50 mm $f/2.8$ lens was used to record the fluorescent screen image. The lamp intensity was not sufficient to allow adequate printing of the 0.1 μsec pictures.

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Electron-Optical High-Speed Camera for the Investigation of Transient Processes

By V. S. KOMELKOV, Y. E. NESTERIKHIN and M. I. PERGAMENT

This electrostatic deflection image-converter system has speeds up to 5×10^6 frames/sec, and exposures as brief as 5×10^{-8} sec. The number of frames in a subseries can be 4 or 8. The total number of frames in a series is 16. The exposure time for each frame can be varied during the series. The maximum exposure variation from 1st to 16th frame is a factor of 20. Frame size is 5 mm $\times$ 5 mm. Resolution is 30 lines/mm. The equipment can also take a series of four streak records at controllable intervals. A discussion is given of the effective aperture ratio of the converter plus input and output lenses, for various electrical and optical magnifications.

Most transient processes which are of interest in modern physics are not accompanied by the strong radiation which facilitates the photographic recording of explosions, high current discharges in gases at high pressure, combustion, etc. To photograph time-resolved radiation spectra, to investigate the dynamics of high-temperature plasma, to photograph processes by the light of separate spectral lines, and to study scintillation, the initial phases of breakdown and other phenomena, including phenomena which are not selfluminous, use should be made of cameras with high lens speed and high time resolution. Such instruments should possess a wide spectral sensitivity range, ensure a strict synchronization with the process being investigated, allow various modes of taking the pictures — such as single and stroboscopic exposures — and change of exposure from frame to frame, etc.

It is difficult or altogether impossible to satisfy these requirements by the use of optical and mechanical systems, though the development of electron-optical high-speed cameras with appropriate control circuits is quite feasible.

Just as in the case of cathode-ray oscillographs, the task of designing electron-optical high-speed cameras consists of two related but still independent problems: the design of image converters, and the design of control circuits ensuring photographic recording with the required parameters, and in conformity with the assigned mode of operation.

We know that image converters can be used both for streak records and for single exposures. Both these modes of operation which are predominant in physical investigations were employed in the first types of converters with magnetic deflections[1]; and it was shown that single exposures could be made as brief as 10^{-8} sec.[1,2] For obvious reasons, magnetic deflection of an electron image could not be attained at high camera speeds. The greatest camera speed with magnetic deflection and an impulse electrostatic shutter was 2×10^6 frames/sec.[3] There are a number of disadvantages inherent in a system which separates the frames by a single linear scan. The frames are usually elongated rectangles and this may be an unsuitable shape. The resolution in the sweep direction is relatively low. There is a strong dependence of the maximum exposure on the camera sweep speed. These disadvantages reduce the applicability of such designs.

Therefore, the authors considered that systems employing electrostatic deflection looked more promising.*

Circular continuous scanning of the image on the screen[4] is performed fairly simply and gives maximum time resolution. Multi-frame photography is more complicated. It can be carried out in two ways: either by taking several pictures on the screen of the same tube, or by taking consecutive single pictures on separate tubes.

The latter method makes the minimum demands on the converter, and makes it possible to use simpler and more reliable control circuits.[15] In this case better time resolution and larger frames can be obtained than with the use of a single tube. However, this method requires special selection of converters in order to ensure the identity of the parameters of the photocathodes.

Multi-frame photography with one converter complicates the control circuit and the design of the image converter, and diminishes the size of the image. On the other hand, it allows a greater number of exposures to be made, and drastically reduces the total number of optical devices operating in conjunction with the converters. It also obviates the necessity for the selection and matching of photocathodes. This design makes possible a continuous and wider range of camera speeds and exposures.

Scanning voltages for multi-frame photography with a single tube can be supplied by hard-valve circuits, or by thyratron circuits, or by cable circuits.[5] Cable circuits are simple and reliable, but can be used only in rare special cases, since with them it is difficult to make changes of exposure and camera speed. Moreover, with cable circuits it is impossible to arrange for stroboscopic operation or for long exposures. On the grounds of complexity and total number of elements, thyratron circuits are not inferior to hard-valve circuits. However, they are less flexible; they are more difficult to synchronize; it is more difficult to vary the operation; and they possess neither sufficient repetition frequency in the

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Editors' Note: Experience in the U.S.A. indicates that magnetic converters generally give better definition than electrostatic converters. Further, the shape of the image frames may be chosen according to the problem at hand, and the exposure can be made independent of the framing rate within reasonable limits. See, for instance, Ref. 18.

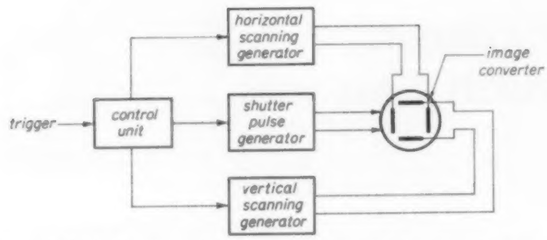

Fig. 1. Block diagram of the arrangement for photography with controlled image converters.

stroboscopic mode, nor sufficient stability. Despite their relative complexity the hard-valve circuits can ensure a high stability of the operating pulses. Thus their mobility and universality meet the most varied requirements.

Control System of Image Converters

Multi-frame photography employing controlled image converters is effected by shifting the electron image in steps in horizontal and vertical directions. Exposure is made at the moment the image stops. Accordingly, multi-step deflecting pulses are supplied to the horizontal and vertical plates of the converter, and rectangular pulses (triggering the converter) to the shutter plates. The number of frames in a row and the number of rows are determined by the number of "steps" of the deflecting pulses. The repetition rate of the camera is determined by the time interval between steps.

The fact that the deflecting pulses should be highly stable and symmetric makes their shaping rather difficult. To obtain satisfactory image resolving power the variation of the "level" of kilovolt pulses should be maintained within 0.1 to 0.5% of their amplitude; and the asymmetry of potentials of different polarity across the deflecting plates within 0.2 to 0.5% of the voltage across the image converter. The latter requirement necessitates the use of currents of both polarities for deflection. In practice with conventional scanning, this considerably reduces both the magnitude and speed of deflection due to the difficulties in the shaping of high-voltage *positive* pulses.

The scanning method suggested here obviates these difficulties and makes it possible to employ only *negative-polarity* pulses for deflection. In this method, the two negative multi-step pulses, one an ascending "staircase" and the other a descending "staircase," are fed to the different deflecting plates of a pair. Together with the equivalent, constant, positive bias supplied in advance to both plates, these pulses form a number of equal and opposite voltages. Symmetry is readily obtained by regulating the bias.

The present instrument of this design employs four-step pulses for both horizontal and vertical deflection. This presents the images in four rows, four frames in a row. Accordingly, the generators for horizontal and vertical deflection are identical, but they are so triggered that the duration of the "steps" of the first is exactly four times smaller than those of the second.

The block diagram of the entire arrangement is shown in Fig. 1. The control unit is switched on by the phenomenon under investigation, and produces series of pulses determining the camera speed, the time of exposure of each frame, time intervals between the series, etc. Signals sent from the unit control the shaping of deflecting and blanking pulses.

Step pulses are formed by a circuit with a common plate load similar to the one employed in "potentialoscope scanning."[6,7] The circuit diagrams of output cascades and current and voltage functions are given in Fig. 2. A feedback system compensates for the insufficiency of the plate resistance of the output valves, so that their currents are equal; $i_{a_1} = i_{a_2} = i_{a_3} = i_{a_4}$. With $R_1 = R_2 = R_3 = R_4$, this gives equal increments in the levels of the adjacent "steps."

The pulses driving the output stages are shaped in advance by symmetric triggers in response to the signals coming from the control unit. Rectangular positive pulses with an amplitude to 50 v and rise times of 10^{-7} sec are fed from the trigger anodes to the shapers. The latter are type 6BIπ secondary emission valves. Operating intermittently, these valves can supply from their dynode to the grid load of the output valves positive pulses with an amplitude of 100 v and rise times of

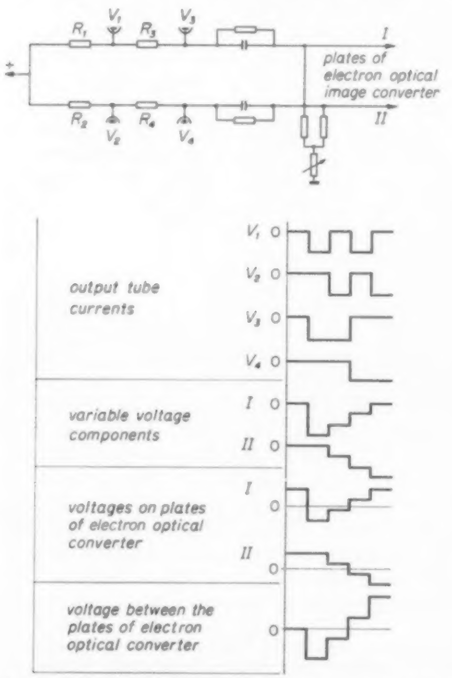

Fig. 2. The circuit diagram of output cascades; and current and voltage functions.

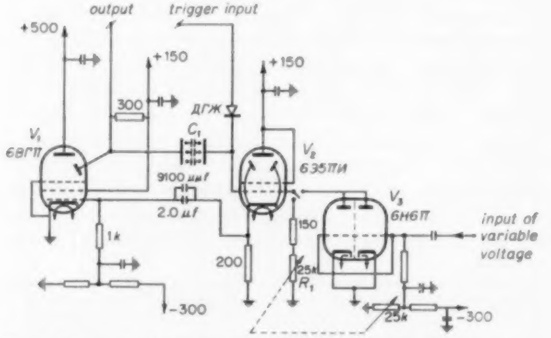

Fig. 3. Diagram of the shutter pulse preshaping circuit.

Fig. 4. Oscillogram of a light flash passing through a CφP camera; camera speed is 10^6 frames/sec: time marks are every 0.2 μsec.

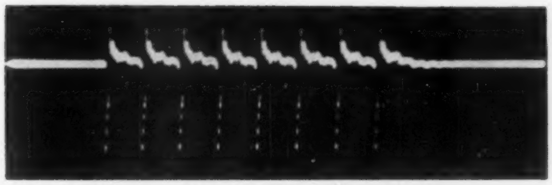

Fig. 5. Oscillogram of a series of sampling pulses.

2 to 3 $\times$ 10^{-8} sec. As in the grid circuits of the shapers, there is squaring and clipping of the signals in the grid circuits of the output valves. This makes it possible to obtain multi-step pulses: with the level stability of the "steps" = 0.1 to 0.3%, with the difference between the levels 200 to 300 v, with the rise times 3 to 5 $\times$ 10^{-8} sec, and with the width of the "steps" from 2 $\times$ 10^{-7} sec to 2 $\times$ 10^{-4} sec.

Figure 3 shows how blanking pulses are formed. The circuit is triggered by the positive signals sent from the control unit. The duration of the positive pulses taken across the dynode is determined by the capacity of the isolating capacitor C_1 and the leakage resistance of the cathode follower R_1 As can be seen from the diagram the latter can be replaced by the triode $Л_3$. A change in the exposure of individual frames during the photographic sequence is effected by control of its grid. As in the sweep generators, after the shapers, the twice-shaped pulses act on the grid of the output valve. The square-formed shutter pulses are fed to the compensated shutter[10] of the image converter. These pulses have an amplitude of 2.5 kv and rise times of 2 to 3 $\times$ 10^{-8} sec. Their level stability is $\approx$0.1%; and their width is from 5 $\times$ 10^{-8} sec to 5 $\times$ 10^{-6} sec.

The control unit which ensures photography in conformity with the chosen instrument technical parameters is a trigger generator with nine channels. A typical output is shown in Fig. 5.

When the horizontal-sweeping generator is replaced by a generator giving a linearly changing voltage, the instrument can operate as a camera producing on the converter screen four streak images with controllable time intervals between them.

The main specifications for an electron-optical high-speed camera using a type ЛИМ-3 image-converter tube are given below:

(1) camera speed from 10^5 to 5 $\times$ 10^6 frames/sec,

(2) exposure from 5 $\times$ 10^{-8} to 5 $\times$ 10^{-6} sec,

(3) controllable exposure variation from 1st to 16th frame — 1 : 1 to 20 : 1,

(4) delay between the master pulse and exposure — from 10^{-7} to 10^{-4} sec,

(5) number of frames in a subseries — 4 and 8 at choice,

(6) time interval between the subseries — from 0 to 10^{-4} sec,

(7) resolving power — 30 lines/mm,

(8) frame size — 5 $\times$ 5 mm,

(9) total number of frames in a sequence — 16, and

(10) equivalent relative aperture f/3.

Figures 6, 7, 8(A) and 8(B) show the oscillograms of the scanning voltage and the pictures of a resolution chart recorded from the luminescent screen of this instrument.

Some Comparative Features of Optico-Mechanical and Electron-Optical High-Speed Cameras

Electron-optical super-speed cameras have certain advantages over optico-mechanical types. The main advantages are:

(1) higher effective lens speed,

(2) flexibility of timing and synchronizing which permit any signal to switch on the instrument (e.g. a light signal, an electromagnetic signal, a neutron signal, etc.),

(3) independence of the exposure time and the camera repetition speed, (There is also the possibility of changing exposure from frame to frame in the sequence.)

(4) the possibility of recording a series with any chosen time intervals between exposures,

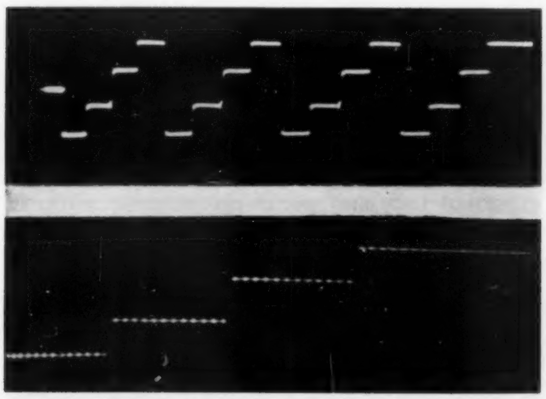

Fig. 6. Oscillograms of 16-frame scanning voltage; time marks are every 0.05 μsec.

Fig. 7. Oscillograms of sweep voltage in the case of two subseries of eight frames; time marks every 0.01 μsec.

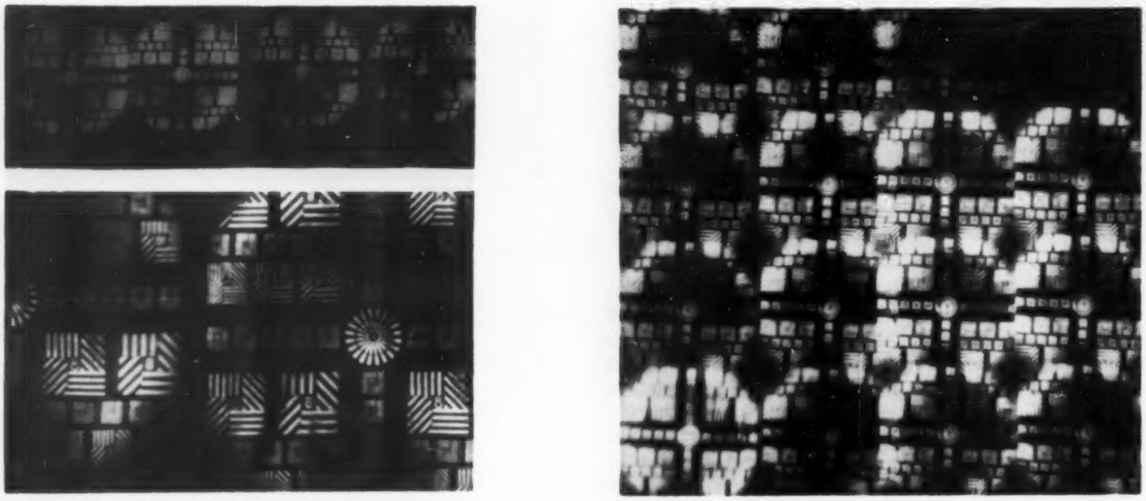

Fig. 8. Picture of a resolution chart illuminated by a flashlamp recorded from a Type ЛИМ-3 Image Converter: (A) camera speed = 2.5 × 10⁶ frames/sec, exposure time = 10⁻⁷/sec;

(B) camera speed = 10⁶ frames/sec, exposure time = 5 × 10⁻⁷/sec. The varying brightness of different areas of the picture of the resolution chart, and the varying brightness of the different frames is due to uneven and varying illumination by the flashlamp.

(5) the possibility of easily introducing marks to correlate the instant of exposure of each frame with oscillograms of other characteristics of the phenomenon being investigated,

(6) the possibility of stroboscopic photography of periodic processes, and

(7) wide spectral sensitivity range.

The simple timing of the control circuits makes it possible to switch on several instruments either for increasing the total number of frames or for increasing the camera repetition rate or for other purposes — for example, for photography in two directions, particularly for stereoscopic photography.

The electron-optical high-speed camera described above possesses most of these advantages.

Of some interest is the comparison of the characteristics of the optico-mechanical camera $C\varphi P$[14] and the electron-optical high-speed camera.

The exposure time of each frame in the type "$C\varphi P$" camera is closely dependent on the camera speed; the time of exposure is longer than the time intervals between exposures. This results in adjacent frames, for part of the exposure time, being exposed simultaneously.

Figure 4 shows an oscillogram of illumination intensity of a spot of size 0.5 mm, photographed by the $C\varphi P$ camera employed as a high-speed camera with a speed of 10^6 frames/sec. The time marks occur on the oscillogram every 0.2 μsec.

As can be seen the illumination curve is a symmetrical triangular pulse with a total duration of 2 μsec. The effective exposure time[8] is found from:

$$\int_0^{t_1} E(t)dt = \int_{t_2}^{t_0} E(t)dt = \frac{1}{10^h}\int_0^{t_0} E(t)dt$$

$E(t)$ is the dependence of illumination intensity on time,

$$h = \frac{S_{max} - S_{min}}{\gamma} =$$

the characteristic interval of photographic material,

γ = the contrast factor of photographic material,

t_0 = the total time of light flash,

$t_2 - t_1 = t_{eff}$ = the effective exposure time, $t_{eff} = t_0\left(1 - \sqrt{\frac{2}{10^h}}\right)$.

The exposure time for photographic material most frequently used in high-speed cameras is given for this case in Table I.

In a type $C\varphi P$ camera the separate points of an image are exposed at different times. Therefore the interval between the beginning of exposure of the first part of the image (in the scan direction) and the end of exposure of the last part (i.e. the whole time within which all the frame is exposed) will be for this case 2.84, 2.72, 2.5 μsec respectively.

According to the manufacturer's data, the resolving power is 16 to 18 lines/mm with an insert comprising four rows of relay lenses, which insert ensures camera speeds up to 1.5×10^6 frames/sec. The equivalent relative aperture is $f/60$.

Thus, electron-optical high-speed cameras employing even the simplest converters are superior to existing optico-mechanical cameras as follows: in aperture ratio, 100 fold; in time resolution, or minimum exposure, 20 to 50 fold; in image resolution 1.5 fold.

Table I.

Type and film	Characteristic interval h	$1 - \sqrt{\frac{2}{10^h}}$	Exposure t_{eff}	$\frac{t_0 f}{1/f}$ frames
Negative "Д"	2.5	0.92	1.84×10^{-6} sec	1.84
Pφ − 1	2	0.86	1.72×10^{-6} sec	1.72
Pφ − 3	1.5	0.75	1.5×10^{-6} sec	1.5

Examination of the Main Characteristics of Electron-Optical Systems

Electron-optical systems have every prospect of becoming instruments for research, as widespread as, for example, cathode-ray oscillographs. Undoubtedly, both multi-stage and single-stage converters will be used. The potentialities of single-stage image converters with regard to the brightness intensification ratio, the resolving power, and the time resolution are far from being exhausted.

Electron optical devices comprise an input lens projecting the image on to the photocathode, an image converter, and an output lens transferring the image from the screen on to the photographic material. The light intensity on the latter can be represented in the form:

$$E = \Pi \frac{B_0(1 - K_1)\eta(1 - K_2)}{4L_1^2(1 + M_1)^2 m^2 \cdot 4L_2^2(1 + M_2)^2} \qquad (1)$$

where B_0 is the brightness of the object, M_1 and M_2 are the linear enlargements of the input and output lenses respectively; $1/L_1$ and $1/L_2$ are their relative apertures, K_1 and K_2 are the lens loss ratios, η is the brightness intensification ratio for an electronic enlargement ratio of unity, m is the linear electronic enlargement. For single-stage image converters $\eta = \pi\varphi\gamma u$ where φ is the sensitivity of the photocathode in amp/lumen, γ is the luminous efficiency of the screen in lumen/watt; u is the voltage across the converter. According to the data,[10] the brightness intensification ratios of the ли M-3 converter (reduced to an enlargement of 1 : 1) are respectively 64 and 32 for versions with antimony-caesium and oxygen-caesium photocathodes.

Proceeding from Eq. (1) the equivalent relative aperture of the electron-optical system can be obtained in the form:

$$\frac{1}{L_{eq}} = \sqrt{\frac{\eta(1 - K_2)}{4L_1^2L_2^2(1 + M_2)^2m^2}} \qquad (2)$$

It is clear from the analysis of Eq. (2) that the aperture ratio of the system $1/(L_{eq})^2$ increases as m and M_2 diminish. The limit to such diminution is set by the resolving power of the converter itself, and the output lens and photographic material. However, as can be seen from Eq. (2), it is possible by varying m and M_2 within certain limits so that their product M_2m = constant, and without decreasing the system resolving power, essentially to raise its aperture ratio. With the presently available sizes of the photocathode, and the present resolving powers of the photocathode, screen, lens and photographic material, the maximum value of the product M_2m is apparently equal to or slightly below unity. Better results can be obtained by increasing the size of the photocathode in the controlled converters with electronic enlargement smaller than unity ($m < 1$).

Of no less importance is the fact that as m decreases the required light intensity on the photocathode (for the same degree of darkening of the photographic material) also diminishes. This makes it possible to use shorter exposures without overstraining the photocathode, i.e., without losing the resolving power.

The photocathodes in modern converters are their "vulnerable points." As is shown elsewhere,[13] the conductivity and sensitivity of the cathodes determine the time resolution of electron-optical systems. There is hope that the application of new materials, for example multi-alkali coatings[11,12] with a sensitivity four times greater than the sensitivity of the existing types, in addition to better methods of coating and use of the transparent support, will markedly improve the main parameters of the photocathodes.

In conclusion the authors express their profound gratitude to engineer F. S. Novik, engineer G. T. Baranov and engineer B. N. Semyonov for valuable advice they offered on separate issues and to laboratory assistants V. A. Gorin and F. Y. Nikolayev who directly participated in the present work.

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(The editors would like to draw attention to three American papers on work on multiple-frame image converter cameras somewhat similar to the work described in the paper above; and to one British paper that discusses resolution and gain:

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A New Type of Ultra-High-Speed Framing Camera Combining a Rotating Mirror With a Film Drum

By TSUNEYOSHI UYEMURA

This paper describes three new framing cameras, each of which combines a high-speed rotating four-face mirror with a low-speed rotating film drum. Typical features of one camera are: continuous writing system, 120,000 frames/sec, 200 exposures per run, 1 μsec minimum exposure time, rotating mirror motor-driven at 90,000 rpm, rotating film drum of 60-cm diameter motor-driven at 900 rpm, effective aperture f/9, frame size 5 mm × 20 mm. A second similar camera can operate at twice as many frames/sec. Exposure time can be maintained at the minimum value, and 200 exposures per run can be taken at low framing rates. A third camera is being made to take 2000 frames at 10^6 frames/sec.

THE AUTHOR has previously produced two drum cameras, Type M-3[1] and M-4[2]. Because of the finite strength of the film drum, the maximum velocity of a film is limited to 600 m/sec; and the maximum framing rate is in the range of 100,000 to 200,000 frames/sec. Rotating mirror cameras can operate faster than this. They have a group of stationary "cameras" on the circumference of a circle with the rotating mirror as its center. A real image of the object is formed on the rotating reflector. The stationary camera lenses form successive real images of the object as its beam of light sweeps past them.

The author has designed a new type of ultra-high-speed camera combining the advantages of the rotating-mirror type and those of the drum type. As first models he has completed a Type MLD-1 camera with a rate of 120,000 frames/sec; and a Type MLD-2 camera with a rate of 240,000 frames/sec. A new model with a rate of over 1,000,000 frames/sec is now being made.

Presented on October 20, 1960, at the Fifth International Congress on High-Speed Photography in Washington, D.C., by Tsuneyoshi Uyemura, Institute of Industrial Science, University of Tokyo, Tokyo, Japan.

The MLD-1 Camera

Figure 1 shows the mechanical and optical arrangement of this camera. Light enters through the main lens L_1 after reflection from the mirror M_0, and is brought to a focus near the face of the rotating mirror *RM*. The beam of light is split near L_1 by two mirrors (M_1) into two symmetrical paths. The right half is reflected from M_1 and M_2 to form a primary image near the surface of the four-sided rotating mirror. The secondary real images I_2 are formed by the lenses L_2 on the film reeled inside the rotating drum. The images I_2 are each half the size of the image I_1. There are in all 20 lenses L_2 arranged in two groups of ten. Twenty frames are taken during a 90° rotation of the tetrahedral mirror. The third lens L_3 is a field lens for the more efficient utilization of the light. The size of a single frame is 5 × 20 mm and the pitch spacing of successive frames is 50 mm. By shifting the film and the drum 5 mm during each 90° rotation of the mirror, overlapping exposures can be prevented. Each lens L_2 can form 10 frames without getting double exposures. Thus, one can obtain a continuous sequence of 200 frames.

Fig. 1. Optical system and mechanism of the MLD-1 camera: RM, rotating mirror; D, film drum; L_1, first lens; L_2, secondary framing lenses (relay lenses).

Table I. Design and Performance Details of the Type MLD-1 Camera.

Type	Continuous writing system
Maximum framing rate	120,000 frames/sec
Exposures per run	200 frames
Minimum exposure time	1 microsecond
Frame size	5 mm × 20 mm
Film	35mm standard film
Rotating mirror	Four faces, face size 30 × 50 mm; 90,000 rpm, motor driven
Rotating film drum	Diameter 60 cm; 900 rpm, motor driven
Optical system	1 objective lens: focal length 525 mm $f/8$ 2 field lenses: focal length 200 mm $f/5.6$ 20 relay lenses: focal length 80 mm $f/3.5$
Resolution	35 lines/mm (using Tri-X film with normal processing)
Effective aperture at film	Approximately $f/9$
Camera size	80 cm × 80 cm × 70 cm
Weight	Ca. 190 kg

Fig. 2. The author, the MLD-1 camera, and accessory equipment.

Fig. 3. View of MLD-1 camera with cover removed.

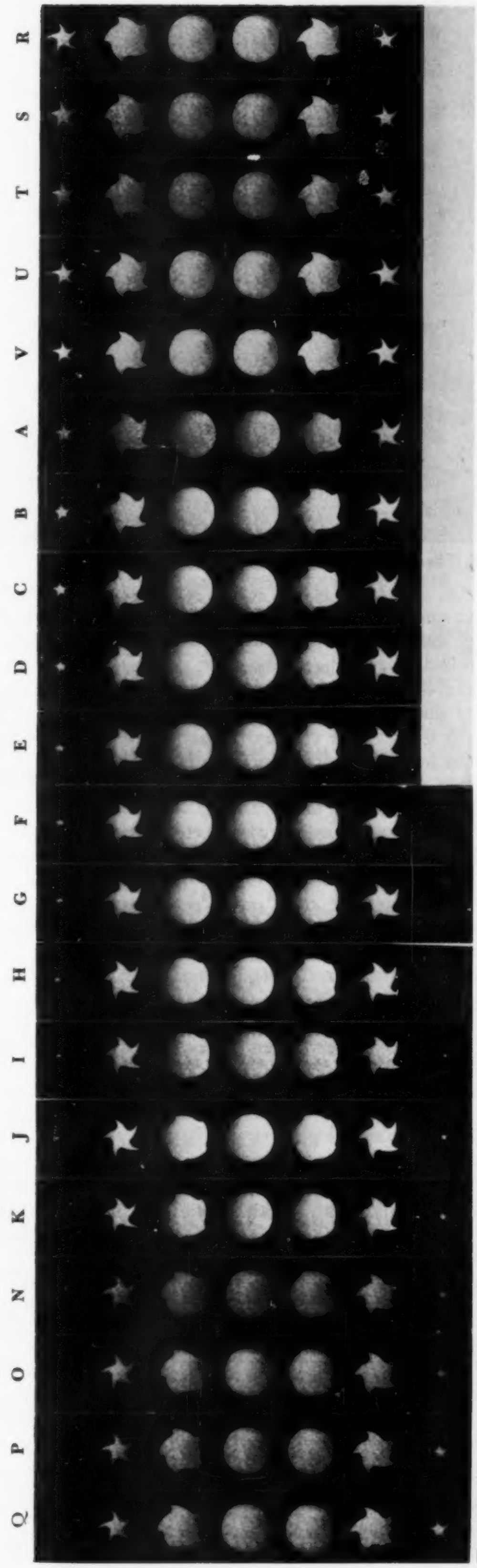

Fig. 4. Action of a new between-the-lens shutter at the nominal exposure time of 1 msec; framing rate, 73,000 frames/sec; exposure time for each frame, 2 μsec. Letters above refer to secondary lenses shown in Fig. 1.

Fig. 5. The MLD-2 camera.

The smearing of the image caused by moving the film is very small. In any case it can be overcome by applying the principle of image movement compensation, if the first real image I_1 is formed a few millimeters *off* the surface of the rotating mirror RM. The exposure time of a single frame can be reduced to one-tenth of the frame time by inserting a stationary diamond stop behind the first lens L_1 and before every second lens L_3. Details of the MLD-1 Camera are given in Table I.

If some of the lenses are covered with suitable caps, the interval between frames and the total writing time can be increased without changing the exposure time for each frame; the total number of frames need not be reduced. For instance, using only one of the twenty framing lenses and running the rotating mirror at full speed, the framing rate is 6000 frames/sec. In this case, the exposure time of a single frame is (as before) one microsecond; and a total time of 1/15 of a second can be photographed, as 400 frames can be taken in continuous regular succession.

Other features to be noted are:

(1) Synchronization of events is not required as the camera is continuous writing.

(2) By rotating the reflector mirror M_0 on top of the camera, events in any position can be photographed. The relative direction of the long dimension of the format can also be adjusted.

(3) The camera is small and light.

(4) In normal operation, only two 90° segments of the film are used. The other two segments can be used for simultaneous streak and cathode-ray oscilloscope recording.

(5) To limit the length of a run, a flashlamp of proper duration or a mechanical shutter may be used.

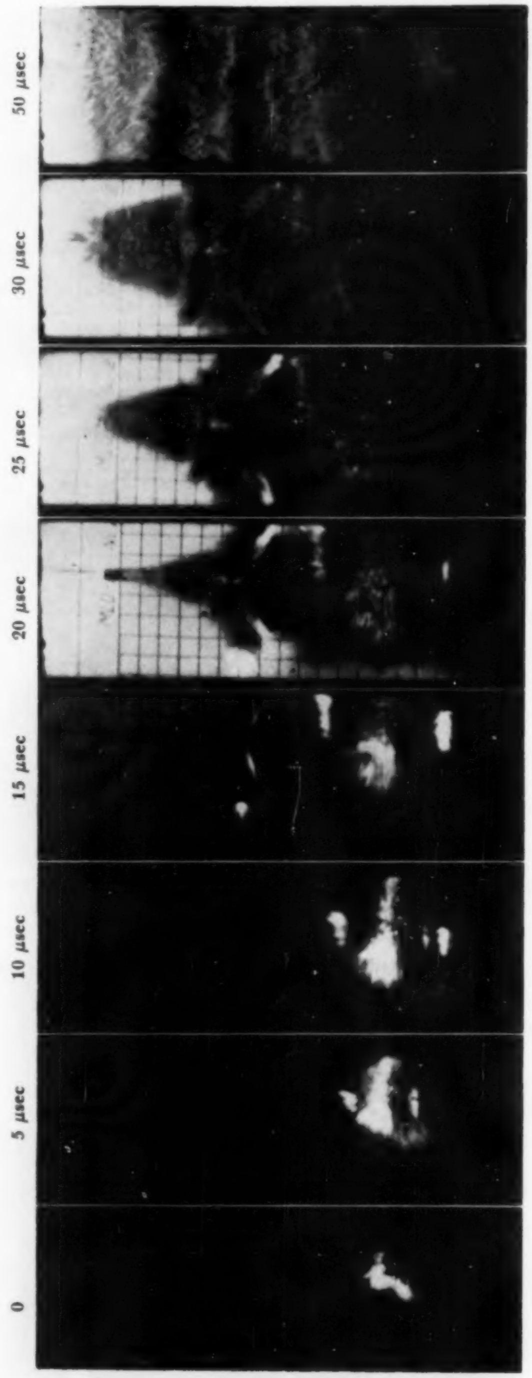

Fig. 6. Exploding primacord by reflected light from an electronic flash tube: framing rate, 210,000 frames/sec; exposure time for each frame, 1.4 μsec.

Figure 2 shows the external appearance of the Type MLD-1 Camera. Figure 3 shows the internal mechanism of the same camera.

Figure 4 is a set of pictures taken at the rate of 73,000 frames/sec, with an exposure time for each of 1/450,000 of a second. These pictures show the operation of a between-the-lens shutter recently made in Japan, with high-speed exposure time of 1/1000 of a second.

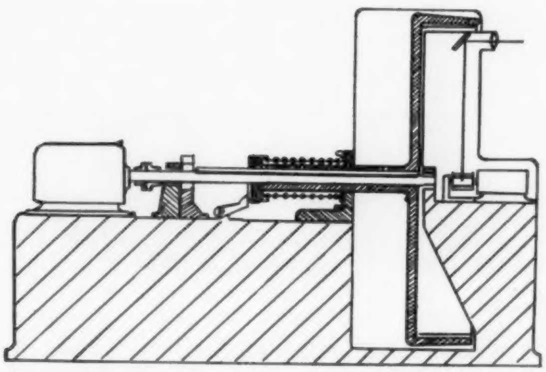

Fig. 7. Mechanism of the new camera now being designed: framing rate, more than 1,000,000 frames/sec; number of frames in a sequence, 2,000.

The MLD-2 Camera

Following the same concepts, a second camera, Type MLD-2, has been built. This camera is of sturdier construction and has 40 relay lenses instead of 20 as in the MLD-1. The framing speed is thereby increased to 240,000 pictures/sec. All other specifications remain the same. The camera was completed in August, 1960. Figure 5 shows its external appearance.

Figure 6 shows a few pictures of a cross-shaped primacord exploded by an electric blasting cap, taken by reflected light from an electronic flashtube. The framing rate is 210,000 frames/sec, and the exposure time of each frame is 1/700,000 of a second.

The MLD-3 Camera

Figure 7 shows a drawing of a camera now under construction. This MLD-3 Camera is similar to the MLD-2 Camera in principle, and in general dimensions, but has the following changes:

(1) The mirror is somewhat smaller and will be driven at 400,000 rpm by an air turbine, instead of a motor.

(2) The film will be 100 mm wide.

(3) The film drum will rotate at 4000 rpm, and at the same time will be translated along its axis to increase the total number of frames to 2000. A feature of this axial translation is that double exposure is impossible.

(4) The picture size is decreased to 5 mm × 10 mm, and a framing rate of 1,000,000 frames/sec can be achieved.

Acknowledgments

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Use of High-Explosive Flash for Photography by the Schardin System

By LOUIS DEFFET and RENE VANDEN BERGHE

This transparence method makes it possible to obtain photographic records of explosive phenomena which have a considerable destructive effect and a very intense self-luminosity. It consists mainly in replacing the sparks of the Cranz-Schardin method with explosive flashlamps that are located in air rather than in argon. The intensity of the luminous flux supplied by these lamps has made it possible to arrange recording conditions to eliminate completely the parasitic soft luminosity of the object. The synchronization of the various explosive lamps is assured by the use of a detonating cord. The framing rate can attain 1,000,000 frames/sec with an exposure time of the order of 10^{-1} μsec per image.

The study conducted at the Research Center for the Explosive Products Industry on the transmission of the detonation of explosives in a low-strength enclosure[1] has made it necessary to revise and improve the systems of instantaneous shadow photography used heretofore.

The method which consisted of photographing shadows projected on a translucent screen[2] by means of an explosive flashlamp was discarded in view of the fact that, despite the various improvements made to this type of light source, it proved impossible to overcome the intense luminosity which accompanies the detonation of explosives such as dynamite. The use of butane or of other gases having high specific heat and a low density would have overcome this drawback, but would have automatically entailed a modification of the normal conditions of the tests.

Another way would have been the adoption of the transparence method proposed by Viard, which combines a Kerr cell shutter, an optical condenser and an explosive flashlamp.[3] We have preferred, however, to circumvent the difficulty by adopting photographic recording conditions of such a nature as to assure the elimination of the above-mentioned troublesome luminosities.

Furthermore, it has proved necessary to combine

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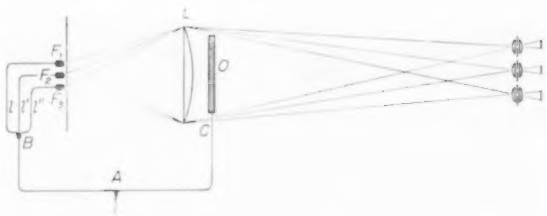


Figure 1

these recording conditions with a method that makes ultra-high-speed cinematography possible, for example, the Cranz-Schardin system.

It is hardly necessary to remind the reader of the very great difficulties usually encountered by research workers when they resort to the above procedure for the study of large, highly luminous explosive charges. We therefore propose a simple, economical method which is now in common use in our laboratories.

This method makes it possible to obtain several successive high-quality transparence photographs of an explosive phenomenon even though it has a very high self-luminosity. Moreover, its highly destructive effect does not prevent us from using the method. The time intervals between these photographs range from 1 μsec to approximately 20 μsec, thus allowing us to obtain a recording rate as high as 1,000,000 frames/sec.

Method of Operation

The principle of the system consists in replacing the sparks of the Schardin system by explosive flashlamps. The synchronization between the phenomenon to be studied and the flashes is assured by the use of detonating cord. Reference to Fig. 1 will facilitate our description of the method of operation.

Three 35mm reflex cameras are used, equipped with objectives having a focal length of 300 mm. The explosive flashlamps F_1, F_2 and F_3 and the optical centers of the three objectives form the conjugate points of the system. These objectives focus the image of the charge

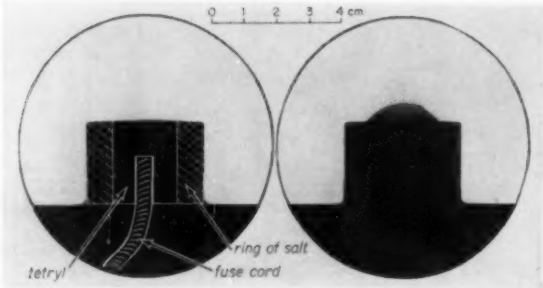


Figure 2

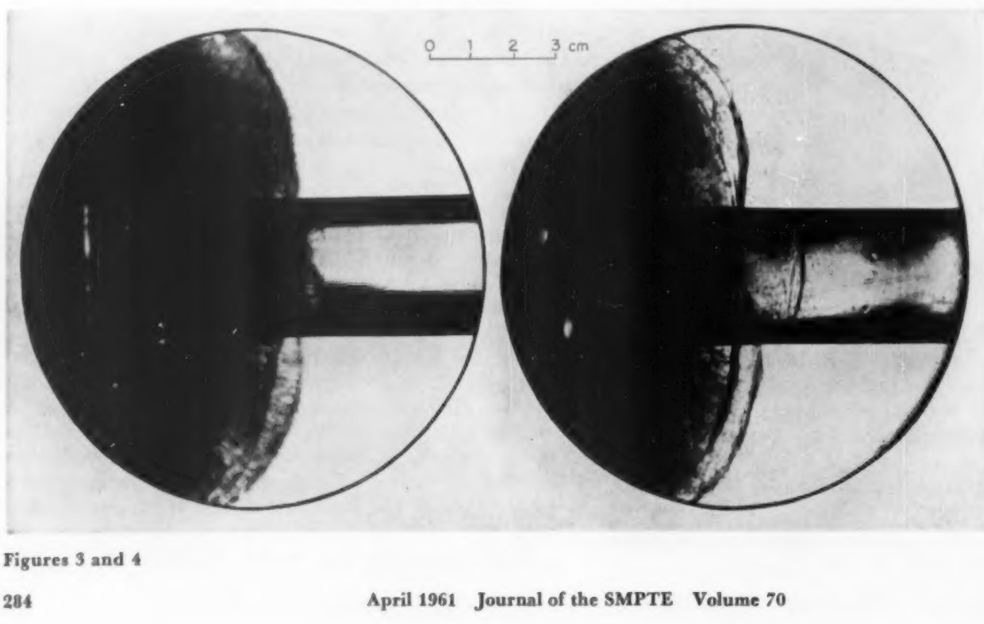
O on the photographic emulsion. The charge O, which is placed a few centimeters from L, is initiated by a detonating cord AC. The main synchronization cord AB and the cord AC are fired simultaneously by a standard electric detonator. The lengths of cord l, l' and l'' determine the various intervals of time that separate the taking of the three photographic recordings.

The field lens consists of a "watch glass" 160 mm in diameter which has been glued to a flat sheet of glass. By filling with water the form thus obtained, one has a condenser of adequate quality for this type of test. At the same time, it is of low cost, an indispensible requirement in view of its being destroyed with each experiment.

The focal length of these lenses is in the neighborhood of 75 cm. However, in order to increase the diameter and the quality of the field lens, provision is made for forming the condenser from unsaturated polyester resin.

Each light source has a transparent circular diaphragm which makes it possible to obtain an image, the diameter of which is smaller than that of the working aperture of the photographic objective. The relative aperture of these objectives is reduced to $f/32$ at the time of the recording. Under these conditions, we obtain a very clear record of the shock waves.

Various types of photographic emulsions were examined before we selected a film manufactured by Gevaert. The main characteristics of this type of film



Figures 3 and 4

are a resolution of 200 lines/mm, a spectral sensitivity extending from the ultraviolet to 500 millimicrons and a speed which may be rated at 3 A.S.A.

It is precisely the combination of these three factors, namely small relative aperture, limited spectral sensitivity and low speed of the emulsion, which has made it possible to satisfy the photographic recording conditions required to avoid the self-luminosity of the explosive.

The explosive lamp consists essentially of a 10-gram tetryl pellet in which there is a cylindrical cavity for the introduction of the detonating cord. The dimensions of the cellulose acetate mask which is placed at the end of the pellet has been determined by means of the method described above. See Fig. 2.

We can now assert that the intense luminosity accompanying the detonation of a large explosive is practically eliminated and that the image obtained is, in all respects, comparable, if not superior, to that obtained by means of Kerr cells.

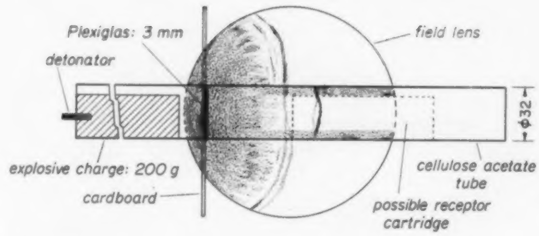


Figure 5

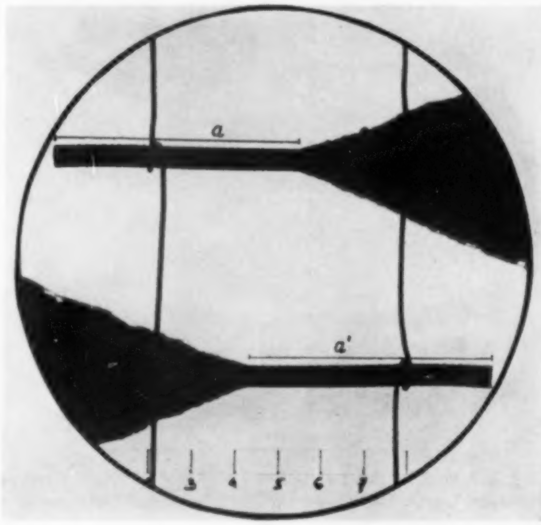


Figure 6

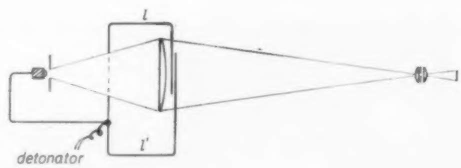


Figure 7

Experimental Study

A number of preliminary tests were made to determine the type of explosive lamp which would best meet our requirements and to evaluate the accuracy of the method. We finally selected a plain explosive lamp, that is, without argon. The intensity of the luminous flux produced by this type of lamp is adequate, and the duration of its emission is shorter than that of an explosive argon flashlamp.

The photographic conditions initially set up permit the almost complete extinction of the luminosity emitted by the passage of the wavefront from the end of the tetryl pellet to its point of contact with the shock wall. Thus it is solely the luminosity produced at the time of the impact that is recorded. This is not the case with the argon-type explosive lamp where the shock wave produces such an intense light that it too affects the duration of the whole flash from the explosive lamp.

An examination of Figs. 3 and 4 permits one to verify this assumption. Figure 3 was obtained by means of an argon-type explosive lamp. The exposure time given by this lamp is of the order of 0.5 μsec.[4] In obtaining Fig. 4, the lamp used was a plain explosive lamp.

This test was conducted on the same type of explosive and with the setup used for the study of the transmission of the detonation in a low-strength enclosure. See Fig. 5.

The second part of this experimental study consisted in determining the accuracy which can be expected from a method using detonating cord for synchronization. When all necessary precautions were taken, it was found that two cords of equal length ($l = l' = 150$ cm), fired by the same detonator, gave at their far ends, a time variation of less than 0.1 μsec; $a = a'$. See Figs. 6 and 7.

The lefthand series of photographs in Fig. 8 was obtained with the arrangement shown in Fig. 1. There was no time delay between the luminous emission of the three explosive lamps in this sequence. On the basis of these recordings it can be asserted that time intervals between photographs of a given sequence can be obtained with a variation not exceeding 0.2 μsec.

It should also be mentioned that it was possible to obtain transparence photographs by using only the luminosity produced by the impact of the detonation products of the core of the cord on the shock wall. The righthand series of photographs in Fig. 8 are three precise successive images of the emergence of the detonation front from the end of a detonating cord.

Also using a detonating cord as the means of synchronization, we perfected a method, deriving directly from the above system, which makes possible the combination of ultra-high-speed photographs by reflection and by transparence. In the field of research on the physics of detonation, certain authors have, as a matter of fact, adopted photographing methods which attempt to combine two interesting aspects of a given phenomenon, namely the visualization of the shock wave and viewing by reflected light.

The defect, common to these various methods, lies in the fact that the light beam emanating from the explosive lamp strikes the principal axis of the system obliquely, thus automatically producing a shift of the shadow photograph in relation to the "direct" photograph. Furthermore, these methods are applicable

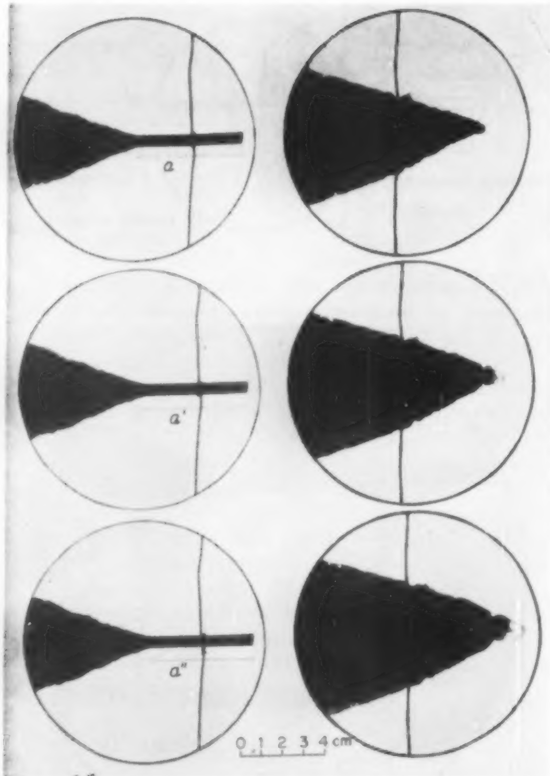


Fig. 8. Left: The three explosive lamps were synchronized for the same instant. Distances a, a' and a'' determine the precision of the recording method. Right: The detonation front reaches the end of a detonating cord; three successive pictures recorded at the rate of 1,000,000 frames/sec.

only to explosives of low luminosity; unless, of course, one uses ultra-high-speed shutters, which entail other drawbacks.

Figure 9 shows a stage of the detonation of a safety explosive cartridge with a rigid sheath. To obtain the "direct" photograph, the explosive lamp is equipped with a biconvex lens designed according to the same principle as the field lens. It is located 30 cm from the subject and produces a highly concentrated light beam. See Fig. 10.

The field lens was colored light red by means of a potassium bichromate solution, thus enabling us to obtain a balance between the transmitted luminosity and that resulting from the photograph by reflection. The use of low-speed nonchromatized film and of a small relative aperture ($f/22$) once more makes possible the application of this method to luminous explosives.

It should also be noted that the introduction of several explosive lamps (transparence method) does not entail any difficulties, and that it is thus possible to obtain three different positions of the shock wave in relation to a stage defined by the "direct" photograph. This method finds its full significance when it is desired to determine the relative position of the shock wave, of the gases and of the solid particles of a given phenomenon.

A direct, objective study on the transmission of detonation[5] was made possible by utilizing the method which is the main subject of this paper.

During this investigation, we attempted to determine the action of the various agents governing the reinitiation phenomenon, while keeping as closely as possible in contact with the practical conditions of the transmission of the detonation within a mine charge-chamber. Figure 5 shows the arrangement used for this study. The purpose

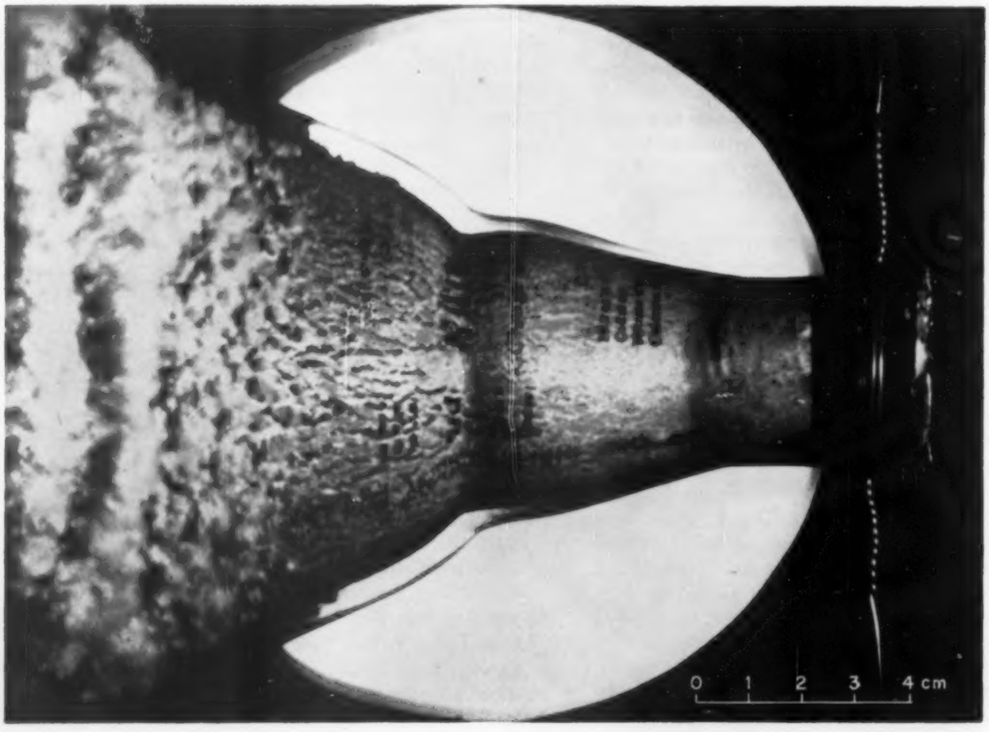


Fig. 9. Detonation of a cartridge with a rigid sheath. This is a "direct" photograph taken by reflected light.

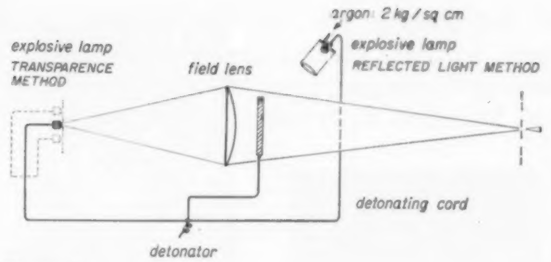


Figure 10

of the cardboard collar which encircles the acetate tube is to retard the detonation products outside the tube. The Plexiglas disc makes it possible, in certain cases, to increase the separation between the shock wave and the gases, which results in a separate action of these two elements on the receptor cartridge. This may permit an easier elucidation of the time to reinitiation.

Figures 11, 12 and 13 show clearly the evolution of such a reinitiation.

Conclusions

Through a suitable combination of the conditions of the photographic recording, it was possible to obtain, by transparence, excellent photographs of highly luminous explosive phenomena. The photographing rate may be as high as 1,000,000 frames/sec, with a precision of 0.2 μsec. The exposure time for each frame is of the order of 0.1 μsec.

The advantage of this new method lies chiefly in the fact that it can be used for the photographic recording of the shock waves and detonation products of explosives having great luminosity and brisance.

Acknowledgments

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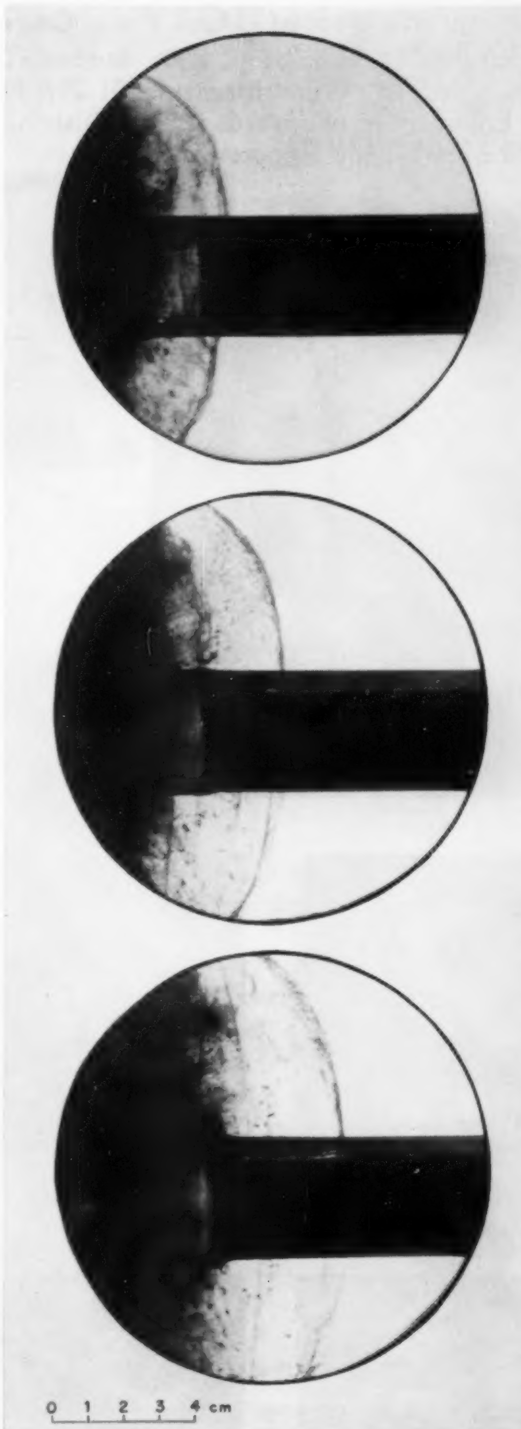

Figures 11, 12, and 13 (top to bottom).

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Student Chapters

CITY COLLEGE OF NEW YORK

Faculty Adviser, Martin D. Rich, Institute of Film Techniques, CCNY, 139th St. and Convent Ave., New York 31

Chairman, Tony Lover, Jr.; *Secretary-Treasurer*, Larry Karabaic

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Faculty Adviser, Hollis Todd, Rochester Institute of Technology, 65 Plymouth Ave., South, Rochester, N. Y.

Chairman, Richard Walker; *Secretary-Treasurer*, Donald Gaffney

UNIVERSITY OF MIAMI

Faculty Adviser, Sydney Head, University of Miami, P. O. Box 8106, Coral Gables, Fla.

Chairman, Ronald Gruchy; *Secretary-Treasurer*, G. Ross Dye

UNIVERSITY OF SOUTHERN CALIFORNIA

Faculty Adviser, Herbert E. Farmer, Dept. of Cinema, University of Southern California, Los Angeles 7

Chairman, Gary D. Kurtz; *Secretary-Treasurer*, Roy L. Lim

BOSTON UNIVERSITY

Faculty Adviser, Alexis E. Ushakoff, Jr., Boston University, Charles River Campus, 640 Commonwealth Ave., Boston 15

Chairman, Robert E. Rose; *Secretary-Treasurer*

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Executive Secretary, Charles S. Stodter
Secretary & Convention Coordinator, Arline Lewis

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Test Film Sales, Shirley Turner
Office Assistant, John Ferber
Receptionist & Secretary, Doris Weiner

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Chief Accountant & Office Manager, Herbert F. Gramstorff
Bookkeeper, Florence Langenberg

Engineering

Staff Engineer, Alex E. Alden
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Assistant, Eric Hannibal

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SMPTE Administrative Committees

ADMISSIONS. *To pass upon all applications for membership, applications for transfer, and to review the Student and Associate membership lists periodically for possible transfer to the Associate and Active grades, respectively. The duties of each committee are limited to applications and transfers originating in the geographic area covered.*

Frank N. Gillette, *National Chairman*, General Precision Laboratory, 63 Bedford Rd., Pleasantville, N. Y.
Arthur F. Baldwin C. R. Fordyce Robert G. Hufford James L. Wassell

C. R. Fordyce, *Chairman, East*, Eastman Kodak Co., Kodak Park, Rochester 4, N.Y.
Howard A. Chinn Boyce Nemec Rodger J. Ross

James L. Wassell, *Chairman, Central*, Bell & Howell, Wilmette, Ill. Geo. W. Colburn Robert Herbst Kenneth M. Mason

Robert G. Hufford, *Chairman, West*, Eastman Kodak Co., 6706 Santa Monica Blvd., Hollywood 38
Harry Brueggemann Ub Iwerks Ralph Lovell

Arthur F. Baldwin, *Chairman, International*, National Theatre Supply Export, 356 West 44th St., N. Y. 36
Gordon A. Chambers Burton F. Perry Robert C. Rheineck

ADVISORS TO THE PRESIDENT ON EUROPEAN AFFAIRS. *To act as liaison between the Society at large and European firms, individuals and organizations interested in motion-picture and television engineering.*

Great Britain: A. W. Watkins, Metro-Goldwyn-Mayer British Studios, Ltd., Elstree Way, Boreham Wood, Herts, Eng.
Continental: Karl Wurstlin, Kodak Aktiengesellschaft, Hedelfinger Strasse 56–62 Stuttgart-Wangen, Germany

BOARD OF EDITORS. *To pass upon the suitability of all material submitted for publication, or for presentation at conventions, and to control the publication of the* JOURNAL.

Pierre Mertz, *Chairman*, 66 Leamington St., Lido, Long Beach, N. Y.

Harlan L. Baumbach	Carlos H. Elmer	Alan M. Gundelfinger	Walter I. Kisner	Bernard D. Plakun	Deane R. White
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George R. Crane	Lorin D. Grignon	Clyde R. Keith	Herbert W. Pangborn	R. T. Van Niman	Emerson Yorke
Harold E. Edgerton					

E. I. DU PONT GOLD MEDAL AWARD. *To recommend to the Board of Governors annually a candidate who has made outstanding contributions in the development of new techniques or equipment which have contributed to the improvement of the engineering phases of instrumentation and/or high-speed photography.*

Charles W. Wyckoff, *Chairman*, 69 Valley Rd., Needham 92, Mass.

Carlos H. Elmer William G. Hyzer Richard O. Painter Morton Sultanoff

EDUCATION COMMITTEE. *Assist in improving the technical training of engineers and technicians for motion pictures and television and to develop appropriate curricula in educational institutions.*

Edward E. Benham, *Chairman*, KTTV, 5747 Sunset Blvd., Los Angeles 28
Edgar A. Schuller, *Vice-Chairman*, Reeves Sound Studios, 304 East 44th St., New York

Carlos H. Elmer Arthur E. Fury W. E. Gephart F. E. Pontius Philip E. Smith John R. Sullivan

West Coast Subcommittee for Motion Picture Production, Procedures & Services

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West Coast Subcommittee on Education of Laboratory Technicians

W. E. Gephart, *Chairman*, 4537 Placidia Ave., N. Hollywood, Calif.

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West Coast Subcommittee on Use and Handling of Film and Video Tape in Television

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William E. Gephart	Robert G. Hufford	Ralph E. Lovell	Frank G. Ralston	Norwood L. Simmons	Ralph Westfall
Theodore B. Grenier	Harry Lehman				

West Coast Subcommittee on Photographic Instrumentation

Carlos H. Elmer, *Chairman*, 410B Forrestal St., China Lake, Calif.

A. J. Carr Waldo Hunter Roy Wolford Robert L. Woltz

East Coast Subcommittee for Education of Sound Technicians

Edgar A. Schuller, *Chairman*, Reeves Sound Studios, 304 East 44th St., New York 17

Homer Elder Dennis Gunst Arthur Locke Haig A. Manoogian Gus Mortensen Martin Rich Ben Sobin

East Coast Subcommittee for Audio-Video Recording

Arthur E. Fury, *Chairman*, Lux-Brill Productions, 321 E. 44 St., New York 17

Herman Badler Julian L. Bernstein John Richards Seymour Steiger

Chicago Subcommittee for Motion-Picture Science and Engineering

Philip E. Smith, *Chairman*, Kodak Processing Lab., 1712 Prairie Ave., Chicago, Ill.

Jack Behrend William D. Hedden Kenneth M. Mason Hans C. Wohlrab

FELLOW MEMBERSHIP. *To consider qualifications of Active members as candidates for elevation to Fellow, and to submit such nominations to the Board of Governors.*

Norwood L. Simmons, *Chairman*, Eastman Kodak Co., 6706 Santa Monica Blvd., Hollywood 38

Donald E. Anderson, Walter Beyer, Howard A. Chinn, Herbert E. Farmer, Robert M. Fraser, Alan M. Gundelfinger, Robert G. Herbst, G. Carleton Hunt, Eric C. Johnson, James W. Kaylor, Frederick J. Kolb, Gerhard Lessman, Ralph E. Lovell, Glenn E. Matthews, Malcolm D. McCarty, Frank M. McGeary, Garland C. Misener, Robert M. Morris, James L. Pettus, Findlay J. Quinn, Reid H. Ray, Edward H. Reichard, A. C. Robertson, Wesley R. Sandell, John W. Servies, William H. Smith, Ethan M. Stifle, Morton Sultanoff, Harry Teitelbaum, Deane R. White, W. T. Wintringham, William E. Youngs

FINANCIAL ADVISORY COMMITTEE. *To recommend to the President and the Board of Governors plans and policies relative to the Society's long-range financial needs.*

Ethan M. Stifle, *Chairman*, Eastman Kodak Co., 342 Madison Ave., New York 17

G. Carleton Hunt, Donald E. Hyndman, Barton Kreuzer, Byron Roudabush

HISTORICAL AND MUSEUM. *To collect facts and assemble data relating to the historical development of the motion-picture and television industries, to encourage pioneers to place their work on record in the form of papers for publication in the* JOURNAL, *and to place in suitable depositories equipment pertaining to the industry.*

John B. McCullough, *Chairman*, Motion Picture Assn. of America, 28 W. 44th St., New York 36

Joseph E. Aiken, Harold S. Anderson, Syd Cassid, Walter Clark, James Cummings, R. A. Isberg, Don G. Malkames, William R. McCown, Albert Narath, Eugene Ostroff, Malcolm G. Townsley

HONORARY MEMBERSHIP. *To search diligently for worthy candidates who through their basic inventions or outstanding accomplishments have contributed to the advancement of the motion-picture and television industries and to propose such candidates to the Board of Governors.*

Barton Kreuzer, *Chairman*, Astro Electronic Products Division, Radio Corporation of America, Princeton, N.J.

Herbert Barnett, Axel Jensen, Reid H. Ray, James L. Wassell

JOURNAL AWARD. *To recommend to the Board of Governors the author or authors of the most outstanding paper originally published in the* JOURNAL *during the preceding calendar year to receive the Society's Journal Award.*

John L. Forrest, *Chairman*, Ansco, 40 Charles St., Binghamton, N. Y.

Leroy M. Dearing, H. Theodore Harding, Wilbur G. Hill, T. Gentry Veal

HERBERT T. KALMUS GOLD MEDAL AWARD. *To recommend to the Board of Governors annually a candidate who has made outstanding contributions in the development of color films, processes, techniques or equipment useful in making color motion pictures for theater or television use.*

Herman H. Duerr, *Chairman*, 59 West End Ave., Binghamton, N. Y.

Albert A. Duryea, Wadsworth E. Pohl, Cyril J. Staud, J. Paul Weiss

MEMBERSHIP. *To solicit new members and to arouse general interest in the activities of the Society and its publications.*

Howland Pike, *National Chairman*, Ansco, 3408 Wisconsin Ave., N. W., Suite 211 Washington 16, D. C.

C. W. Wood, *Chairman, Atlanta*, Eastman Kodak Processing Lab., 4729 Miller Dr., Chamblee, Ga.

Richard Dumphey, Bernard Elias, Ralph Haburton, Albert Roberts, Katherine Stenholm, Durward Thayer

Boston

Canadian

William D. Hedden, *Chairman, Chicago*, Calvin Productions, Inc., 1105 Truman Rd., Kansas City 6, Mo.

E. Raymond Arn, Donald T. Balousek, Ray Balousek, Robert F. Blair, Robert A. Colburn, John W. Ditamore, Malcolm L. Fleming, Clifford Hanna, Harold E. Hanson, Orlando S. Knudsen, Kenneth M. Mason, John H. Maynard, John I. Newell, Reid H. Ray, James L. Wassell

Dallas-Fort Worth

Harry J. Lehman, *Chairman, Hollywood*, 6325 Santa Monica Blvd., Hollywood 38

Edward E. Benham, R. W. Casey, John DuVall, Ted Fogelman, Harvey Gausman, Raymond F. Grant, Theodore Grenier, Alan M. Gundelfinger, John F. Kelly, John Lehners, A. C. Macauley, John Nicholson, Mel Sawelson

William R. McCown, *Chairman, Nashville*. Box 6215, Nashville, Tenn.

Jack Decker, G. Kenneth Futrell, Ralph Hucaby

New York

Eric Yavitz, *Chairman, Rochester*, Eastman Kodak Co., Bldg. 35, Kodak Park, Rochester 4, N. Y.

D. F. Lyman, Charles H. Evans

San Francisco

James H. Culver, *Chairman, Washington*, Head Mct.-Pic. Collection, Library of Congress, Washington 25, D. C.

Don Duke — Henry M. Fisher — Arthur L. Foster — Jack C. Greenfield — Robert E. Johnson — Byron Roudabush

Foreign

AUSTRALIA: F. J. Appleton
BOLIVIA: M. Kavlin
CHILE: F. W. Lowe
CHINA: Harry More
DENMARK: R. Sorenson
EGYPT: W. M. Sirry
ENGLAND: W DeLane Lea
FORMOSA: Yeh Li
FRANCE: A. Gillet
HAWAII: G. Tahara
INDIA: P. Kapila
ITALY: V. Trentino
JAPAN: Yoshio Osawa
LEBANON: A. S. Mueller
MEXICO: J. L. Fields
NETHERLANDS: E. J. Verschueren
NEW ZEALAND: M. J. Ashley
PAKISTAN: Z. U. I. Sheikh
PERU: J. M. Rosello
PHILIPPINES: H. V. Zeppelin
PUERTO RICO: Juan Viguie
SPAIN: S. M. Escalona
SWITZERLAND: René Boeniger
TURKEY: Kemal Baysal

NOMINATING. *To recommend nominations to the Board of Governors for annual election of officers and governors.*

Norwood L. Simmons, *Chairman*, Eastman Kodak Co., 6706 Santa Monica Blvd., Hollywood 38

Herbert E. Farmer
W. E. Gephart
H. Theodore Harding
Barton Kreuzer
Kenneth M. Mason
Richard O. Painter
Howland Pike
Rodger Ross

PAPERS. *To solicit papers and provide the program for national conventions, maintain a close liaison with the editorial office of the Society relative to manuscripts for publication, and make available to local sections for their meetings papers presented at national conventions.*

Robert C. Rheineck, *General Chairman*, CBS News, 485 Madison Ave., New York 22

Regional Chairmen (United States)

Charles D. Beeland, *Chairman, Atlanta*, Charles D. Beeland Co., 70 Fourth St., N. W., Atlanta 8, Ga.
Harold E. Edgerton, *Chairman, Boston*, MIT, Dept. of Electrical Engineering, 77 Massachusetts Ave., Cambridge 39, Mass.
Jack Behrend, *Chairman Chicago*, Behrend Cine Corp., 161 East Grand Ave., Chicago 11, Ill.
Roddy K. Keitz, *Chairman, Dallas-Ft. Worth*, Keitz & Herndon, Inc., 3601 Oak Grove, Dallas 4, Texas
Edward P. Ancona, Jr., *Chairman, Hollywood*, National Broadcasting Co., 3170 Lake Hollywood Dr., Hollywood 28
Ralph L. Hucaby, *Chairman, Nashville*, 945 Caldwell Lane, Nashville, Tenn.
J. Paul Weiss, *Chairman, New York*, E. I. du Pont de Nemours & Co., Photo Products Dept., Parlin, N. J.
C. Loren Graham, *Chairman, Rochester*, Eastman Kodak Co., Bldg. 65, Kodak Park, Rochester 15, N. Y.
R. A. Isberg, *Chairman, San Francisco*, 2519 Parker St., Berkeley 4, Calif.
Max Beard, *Chairman, Washington*, 10703 East Nolcrest Dr., Silver Spring, Md.

National Regional Chairmen

Western Hemisphere (except United States)

ARGENTINA: Pablo Tabernero, Laboratorios Alex S. A., Dragones 2250, Buenos Aires
BRAZIL: Joseph Illes, Laboratorios Policrom, Rua 13 de Maio, 402, Sao Paulo
CANADA: Rodger J. Ross, Canadian Broadcasting Corp., 354 Jarvis St., Toronto, Ont.
CHILE: Andres Martorell De Llanza, Casilla 3043, Santiago
COLOMBIA: Pablo E. Carrasco, Kodak Colombiana Ltd., Carrera 13, No. 18-66, Bogota
MEXICO: Paul M. Wilson, Kodak Mexicana Ltd. Londres 16, Administracion De Correos 68, Mexico 6, D. F.
PUERTO RICO: Pedro Mabanta, Kodak Puerto Rico Ltd., 305 Ponce de Leon, P. O. Box 5006, Puerta de Tierra, San Juan 4
VENEZUELA: Alfredo J. Rosaiano, Bolivar Films, C. A., Apartado 786, Caracas
PERU: Jose Maria Rosello, Estudios Cinematograficos Rosello, Casillo Correo 3116, Lima

Europe

DENMARK: Michael M. Jacobsen, Filmtech Copenhagen, Jenslovs Tvaervej 1A, Charlottenlund
FRANCE: Fred Orain, 128, Rue La Boetie, Paris 8e
GERMANY: Adolf Kochs, Wilhelm-Keim-Strasse 23, Munich
GREAT BRITAIN: Leslie Knopp, The Cinematograph Exhibitors' Assn. of Great Britain & Ireland, 164 Shaftesbury Ave., London W. C. 2
ITALY: Mario Calzini, Tecnostampa Labs, 38 Via Albalonga, Rome
THE NETHERLANDS: E. J. Verschueren, Wagnerlann 9, Hilvershum
SWEDEN: Osten Soderlund, Hasselblads, Fotografiska AB, Motion Picture Dept., P. O. Box 428, Goteborg 1
SWITZERLAND: Robert Suter, Turicop SA, Regensbergstrasse 243, Zurich 11/50
USSR: ———

Asia

INDIA: H. Krishnan, Kodak Ltd., P. O. Box No. 343, Kodak House, Dr. Dadabhai Naoroji Rd., Bombay 1
JAPAN: Kiyohiko Shimasaki, Motion Picture Engineering Society of Japan, Inc., Sankei-Kaikan Bldg. No. 3 Otemachi-1, Rm. 271, Chiyoda-ku, Tokyo
PHILLIPINES: Juan D. Fornoles, L. V. N. Pictures, Inc., P. O. Box 3610, Manila

Australasia

AUSTRALIA: P. H. Budden, Commonwealth Film Labs, 35 Missenden Rd., Camperdown, N. S. W.
NEW ZEALAND: M. J. Ashley, National Film Unit, Darlington Rd., Miramar, Wellington E. 4

PROGRESS. *To prepare an annual report on world progress in the motion-picture and television industries.*

John M. Calhoun, *Chairman*, Eastman Kodak Co., Mfg. Experiments Div., Kodak Park, Rochester 4, N. Y.

F. Alexander
M. J. Ashley
Max Beard
R. M. Betty
D. J. Bloomberg
P. E. Carrasco
R. C. W. Chung
S. Dahlstedt
L. Didiee
L. G. Dive
J. Doust
R. Fehrmann
E. Finestauri
H. Fix
K. E. Gondesen
K. Gopal
R. E. Gottschalk
M. A. Hankins
G. Hansen
J. D. Hayes
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Tom W. Hope
E. Horvitch
J. Illes
M. A. Issari
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J. Kiel
Walter I. Kisner
Henry N. Kozanowski
James A. Moses
R. S. O'Brien
J. Ogilvie
N. R. Olding
L. W. Ostinelli
F. S. B. Porter
Reid H. Ray
E. H. Reichard
N. H. Rosenthal
W. C. Rubinstein
V. Rudakov
B. Schlanger
E. H. Schreiber
C. A. Seidel
K. Shimasaki
J. W. Stafford
S. Sternberg
M. H. Stevenson
A. C. Symons
J. M. Ungar
F. J. Watson
L. E. West
Z. J. Wystrup

PROGRESS MEDAL AWARD. *To recommend to the Board of Governors a candidate who by his inventions, research, or development has contributed in a significant manner to the advancement of motion-picture or television technology, and is deemed worthy of receiving the Progress Medal Award of the Society.*

John G. Frayne, *Chairman*, 1580 LaLoma Rd., Pasadena 2, Calif.

Harold E. Edgerton | Glenn E. Matthews | Pierre Mertz | S. P. Solow

PUBLICATIONS ADVISORY COMMITTEE. *To review the publication policy of the Society in the light of motion-picture and television progress and in respect to the changing interests of the membership with a view to recommending long-range publication policies to the President and the Board of Governors.*

Glenn E. Matthews, *Chairman*, Eastman Kodak Co., Bldg. 59, Kodak Park, Rochester 4, N. Y.

Walter I. Kisner, *Asst. Chairman*

Max Beard, Roger J. Beaudry, Gerald M. Best, Howard A. Chinn, Robert A. Colburn, Herbert E. Farmer, Pierre Mertz, Reid H. Ray, Robert C. Rheineck

PUBLIC RELATIONS ADVISORY COMMITTEE. *To review the public relations activities of the Society and recommend long-range plans to the President.*

Wilton R. Holm, *Chairman*, E. I. du Pont de Nemours & Co., Inc., 7051 Santa Monica Blvd., Hollywood 38

RETIREMENT PLAN ADMINISTRATIVE COMMITTEE. *To administer the SMPTE Employees' Retirement Plan.*

J. W. Services, *Chairman*, National Theatre Supply Co., 50 Prospect Ave., Tarrytown, N.Y.

Victor H. Allen, E. M. Stifle

REVISIONS COMMITTEE ON CONSTITUTION, BYLAWS AND ADMINISTRATIVE PRACTICES. *To review and recommend to the Board of Governors revisions to the Constitution, Bylaws and Administrative Practices of the Society.*

Herbert E. Farmer, *Chairman*, 7826 Dumbarton Ave., Los Angeles 45

Don M. Alexander, G. R. Crane, Gerald G. Graham, Robert G. Hufford, Wilton R. Holm, Glenn E. Matthews, Reid H. Ray, James L. Wassell

DAVID SARNOFF AWARD. *To recommend to the Board of Governors a candidate who has done outstanding work in some technical phase of the broad field of television or in any similar phase of theater television, whether in research, development, design, manufacture or operation.*

Howard A. Chinn, *Chairman*, CBS-TV, 485 Madison Ave., New York 22, N. Y.

Skipwith W. Athey, Ralph N. Harmon, Henry N. Kozanowski, W. T. Wintringham

SUSTAINING MEMBERSHIP. *To solicit new Sustaining Members and thereby obtain adequate financial support required by the Society to carry on its technical and engineering activities.*

E. M. Stifle, *Chairman*, Eastman Kodak Co., 342 Madison Ave., New York 17

S. W. Caldwell, Jerome C. Diebold, Theodore Grenier, Saul Jeffee, Roddy K. Keitz, Frank M. McGeary, Werner H. Ruhl, William Swann, Charles W. Wyckoff

SAMUEL L. WARNER AWARD. *To recommend to the Board of Governors a candidate who has done the most outstanding work in the field of sound motion-picture engineering, in the development of new and improved methods or apparatus designed for sound motion pictures, including any steps in the process, and who, whether or not a member of the Society of Motion Picture and Television Engineers, is deemed eligible to receive the Samuel L. Warner Memorial Award of the Society.*

Loren L. Ryder, *Chairman*, Ryder Sound Services, Inc., 1161 North Vine St., Hollywood

John O. Aalberg, George R. Groves, George Lewin, Malcolm G. Townsley

SMPTE Engineering Committees

The Engineering Vice-President, D. R. White, has appointed the chairmen and committee members listed below to serve for his two-year term of office, January 1, 1960, through December 31, 1961.

Inquiries regarding committee projects or membership should be directed to Alex E. Alden, Staff Engineer, at Society Headquarters.

COLOR. *To make recommendations and prepare specifications for the operation, maintenance, and servicing of color motion-picture processes, accessory equipment, studio lighting, selection of studio set colors, color cameras, color motion-picture films, and general color photography.*

A. M. Gundelfinger, *Chairman*, Technicolor Corporation, 6311 Romaine St., Hollywood 38

E. P. Bertero, F. J. Bingley, H. E. Bragg, H. P. Brueggemann, A. A. Duryea, R. M. Evans, F. H. Gerhardt, R. E. Harrington, F. P. Herrnfeld, W. R. Holm, R. J. Manteuffel, A. J. Miller, W. E. Pohl, H. C. Ross, L. E. Varden, J. P. Weiss, J. R. Whittaker, W. T. Wintringham

FILM DIMENSIONS. *To make recommendations and prepare specifications on those film dimensions which affect performance and interchangeability, and to investigate new methods of cutting and perforating motion-picture film in addition to the study of its physical properties.*

A. C. Robertson, *Chairman*, Eastman Kodak Co., Kodak Park, Bldg. 35, Rochester 4, N.Y.

J. E. Aiken, W. C. Brandsma, A. M. Gundelfinger, W. G. Hill, A. G. Krienke, R. J. Manteuffel, A. J. Miller, G. C. Misener, R. W. Payne, W. E. Pohl, M. G. Townsley, W. E. Vary

FILM-PROJECTION PRACTICE. *To make recommendations and prepare specifications for the operation, maintenance, and servicing of motion-picture projection equipment, projection rooms, film-storage facilities, stage arrangement, screen dimensions and placement, and maintenance of loudspeakers to improve the quality of reproduced sound and the quality of the projected picture in the theater.*

W. Beyer, *Chairman*, 1110 N. Ardmore Ave., Hollywood 29

M. L. Baron	F. E. Cahill	C. F. Horstman	J. J. Kohler	H. W. Lotz	J. F. Rollman
H. E. Behrens	D. F. Haworth	D. V. Kloepfel	F. D. Leslie	R. J. Manteuffel	J. W. Servies
W. Borberg	C. E. Heppberger				

INSTRUMENTATION AND HIGH-SPEED PHOTOGRAPHY. *To further the development and utilization of instruments and techniques associated with instrumentation and high-speed photography.*

M. Sultanoff, *Chairman*, Ballistic Research Lab., Aberdeen Proving Ground, Md.

M. L. Baron	F. M. Emens	W. G. Hyzer	Kenneth Morgan	H. R. Roglin	J. S. Tamer
D. M. Beard	L. L. Endelman	Harold Jones	J. H. Niemeyer	E. L. Scott	J. H. Waddell
R. M. Betty	G. H. Gordon	J. S. Keller	R. O. Painter	R. D. Shoberg	W. R. Wilson
Alexander Easson	W. C. Griffin	Karl-Heinz Lohse	D. H. Peterson	D. J. Southard	R. L. Wolford
H. E. Edgerton	H. T. Harding	R. J. Manteuffel	A. E. Quinn	L. E. Steadman	C. W. Wyckoff
C. H. Elmer	S. M. Hauser				

LABORATORY PRACTICE. *To make recommendations and prepare specifications for the operation, maintenance, and servicing of motion-picture printers, processing machines, inspection projectors, splicing machines, film-cleaning and treating equipment, rewinding equipment, any type of film-handling accessories, methods, and processes which offer increased efficiency and improvements in the photographic quality of the final print.*

E. H. Reichard, *Chairman*, Consolidated Film Industries, 959 Seward St., Hollywood 38

V. D. Armstrong	G. A. Chambers	T. J. Gaski	W. F. Kelley	R. H. Nothdurft	J. G. Stott
H. L. Baumbach	G. W. Colburn	W. D. Hedden	J. J. Kowalak	R. W. Payne	J. L. Wassell
T. J. Braun	D. W. Dixon	F. P. Herrnfeld	C. F. LoBalbo	W. E. Pohl	R. Westfall
H. P. Brueggemann	H. J. Freedman	R. P. Ireland	E. M. Londre	H. C. Ross	J. A. Widmer
O. E. Cantor	J. S. Fritzen	P. A. Kaufman	R. J. Manteuffel	F. J. Scobey	E. G. Zost

SCREEN BRIGHTNESS. *To make recommendations and prepare specifications for the brightness of the motion-picture screen image, related factors such as ambient light and screen characteristics, methods of measurement in this field, and means for controlling and improving screen brightness.*

Gerhard Lessman, *Chairman*, 935 Sheridan Rd., Evanston, Ill.

M. L. Baron	L. D. Grignon	R. G. Herbst	F. J. Kolb	O. W. Richards	Edward Stanko
R. E. Birr	C. W. Handley	Y. G. Hurd	E. Lachman	Leonard Satz	Allen Stimson
M. H. Chamberlin	A. J. Hatch	L. B. Isaac	R. J. Manteuffel	Ben Schlanger	J. J. Zaro
W. E. Gephart	C. E. Heppberger	W. F. Kelley	Hugh McLachlan		

16MM AND 8MM MOTION PICTURES. *To make recommendations and prepare specifications for 16mm and 8mm cameras, 16mm sound recorders and sound-recording practices, 16mm and 8mm printers and other film laboratory equipment and practices, 16mm and 8mm projectors, splicing machines, screen dimensions and placement, loudspeaker output and placement, preview or theater arrangement, test films, and the like, which will improve the quality of 16mm and 8mm motion pictures.*

R. G. Herbst, *Chairman*, Bell and Howell Co., 7100 McCormick Rd., Chicago 45, Ill.

L. J. Anderson	E. W. D'Arcy	Morris Goldberg	R. C. Holslag	J. A. Maurer	A. C. Robertson
D. L. Babcock	J. L. Forrest	T. B. Gromak	F. J. Kelly	B. F. Melchionni	H. A. Thomson
M. L. Baron	R. E. French	R. G. Hennessy	F. E. Lane	W. H. Offenhauser	R. T. Van Niman
R. E. Birr	D. C. Gilkeson	R. H. Hodges	R. J. Manteuffel	M. Renger	W. R. Wilson

SOUND. *To make recommendations and prepare specifications for the operation, maintenance, and servicing of motion-picture film, sound recorders, re-recorders and reproducing equipment, methods of recording sound, sound-film processing, and the like, to obtain means of standardizing procedures that will result in the production of better uniform quality sound in the theater.*

J. L. Pettus, *Chairman*, RCA, 1560 N. Vine St., Hollywood 28

F. G. Albin	F. A. Comerci	B. H. Denney	J. C. Greenfield	J. A. Maurer	E. A. Schuller
Walter Bach	J. P. Corcoran	H. E. Fracker	L. D. Grignon	J. M. Moriarty	G. M. Sprague
M. L. Baron	I. B. Current	E. W. Franck	W. K. Grimwood	B. F. Perry	E. W. Templin
R. J. Beaudry	E. W. D'Arcy	W. E. Gephart	R. G. Hufford	J. S. Powers	M. G. Townsley
H. H. Brauer	Herbert DeGroot	I. R. Goshaw	A. H. Lind	G. E. Sawyer	R. T. Van Niman
F. E. Cahill	D. L. Demarest	A. P. Green	R. J. Manteuffel		

STANDARDS. *To survey constantly all engineering phases of motion-picture production, distribution, and exhibition, to make recommendations and prepare specifications that may become proposals for American Standards. This committee should follow carefully the work of all other committees on engineering and may request any committee to investigate and prepare a report on the phase of motion-picture engineering to which it is assigned.*

F. J. Kolb, *Chairman*, Eastman Kodak Co., Kodak Park, Building 35, Rochester 4, N.Y.

Chairmen of Engineering Committees

Walter Beyer	A. M. Gundelfinger	Gerhard Lessman	J. L. Pettus	A. C. Robertson	W. T. Wintringham
H. A. Chinn	R. G. Herbst	R. M. Morris	E. H. Reichard	M. Sultanoff	

Members at Large R. E. Birr A. G. Jensen W. F. Kelley D. R. White

TELEVISION. *To make recommendations and prepare specifications on all phases of film equipment used in television broadcasting. Further, to make recommendations and prepare specifications on all phases of the production, processing and use of film made for testing of and transmission over a television system.*

W. T. Wintringham, *Chairman*, Bell Telephone Labs., Murray Hill, N.J.

E. P. Ancona	D. C. Gilkeson	H. R. Lipman	Pierre Mertz	R. E. Putman	T. G. Veal
K. B. Benson	F. N. Gillette	H. A. Manoogian	R. M. Morris	J. H. Roe	W. B. Whalley
V. J. Duke	A. M. Gundelfinger	R. J. Manteuffel	N. R. Olding	D. W. Shields	J. R. Whittaker
J. L. Forrest	H. N. Kozanowski				

TELEVISION STUDIO LIGHTING. *To make recommendations and prepare specifications on all phases in lighting employed in television studios.*

R. M. Morris, *Chairman*, American Broadcasting Co., 7 West 66 St., New York 23

H. R. Bell	C. N. Clark	G. T Howard	R. I. Manteuffel	C. J. Neenan	R. G. Williams
Ulrich Caro	G. H. Gill	H. A. Kliegl	W. R. McCown	Charles Shevlin	W. R. Wilson

VIDEO-TAPE RECORDING. *To propose standards and good engineering practices for the construction, adjustment, operation and measurement of video-tape recording and reproducing equipment and for those video-tape dimensions or other characteristics which affect performance and interchangeability.*

H. A. Chinn, *Chairman*, CBS Television, 485 Madison Ave., New York 22, N.Y.

C. E. Anderson	K. B. Benson	W. K. Grimwood	J. E. Landsburg	R. M. Morris	R. A. von Behren
G. W. Bartlett	R. J. Bowley	Fred Himelfarb	A. H. Lind	H. W. Town	

SMPTE Representatives to Other Organizations

AMERICAN STANDARDS ASSOCIATION

Board of Directors, A. G. Jensen   Standards Council, A. G. Jensen   Photographic Standards Board, D. R. White

Acoustical Standards Board, D. R. White

SECTIONAL COMMITTEES

Motion Pictures, PH22: R. E. Birr, *Chairman*, General Electric Co., Nela Park, Cleveland, Ohio

Alex E. Alden, *Secretary*   A. G. Jensen   D. R. White

Sound Recording, S4, E. W. D'Arcy, J. L. Pettus   *Acoustics S1,* J. L. Pettus   *Photographic Processing, PH4,* C. F. LoBalbo

INTER-SOCIETY COLOR COUNCIL

F. T. Bowditch	R. M. Evans	W. E. Pohl	M. H. Sweet	J. P. Weiss	W. T. Wintringham
H. E. Bragg	A. M. Gundelfinger	W. H. Ryan			

INTERNATIONAL COMMISSION ON ILLUMINATION (C.I.E.)

U. S. National Committee: R. M. Morris   Petro Vlahos   W. T. Wintringham

Member at Large: A. M. Gundelfinger

INTERNATIONAL STANDARDS ORGANIZATION TECHNICAL COMMITTEE (36) ON CINEMATOGRAPHY

The U.S. National Committee is the personnel of ASA Sectional Committee, PH22

International Advisory Group: Alex E. Alden, R. E. Birr, F. J. Kolb, D. R. White

JOINT COMMITTEE ON INTER-SOCIETY COORDINATION (JCIC): D. R. White

This committee was formed some years ago to coordinate the technical activities of mutual interest among the Institute of Radio Engineers, National Association of Broadcasters, Electronic Industries Association and the Society of Motion Picture & Television Engineers.

NATIONAL ELECTRONICS CONFERENCE: R. R. Foley

Annual Awards

A detailed report, including the full text of citations and acceptances, appears in the December 1960 *Journal*, pp. 904-916. A description of the awards and a recapitulation of the recipients of the previous years' awards were last published in the April 1960 *Journal*, Part II.

Distribution of Members by Sections—January 1, 1961

Totals—U.S.: 5301, Canada: 291.

Atlanta . . . . **Total 246**
North Carolina, 13; South Carolina, 15; Mississippi, 4; Alabama, 19; Georgia, 57; Florida, 138

Boston . . . . **Total 127**
Maine, 7; New Hampshire, 7; Mass., 109; Rhode Island, 4; Vermont, 0

Canada . . . . **Total 291**

Chicago . . . . **Total 830**
Colorado, 45; North Dakota, 5; South Dakota, 7; Nebraska, 10; Kansas, 9; Minnesota, 40; Iowa, 18; Missouri, 47; Wisconsin, 28; Illinois, 558; Michigan, 97; Indiana, 48; Ohio, 118

Dallas-Ft. Worth . . . . **Total 113**
Oklahoma, 14; Arkansas, 2; Louisiana, 15; Texas, 82

Hollywood . . . . **Total 1534**
Nevada (S.W.), 6; New Mexico, 19; Arizona, 22; So. California, 1487

Nashville . . . . **Total 45**
Kentucky, 7; Tennessee, 38

New York . . . . **Total 1560**
Connecticut, 81; Pennsylvania, 138; New Jersey, 319; S.E. New York, 1022

Rochester (N.W. New York) . . . . **Total 319**

San Francisco . . . . **Total 254**
Montana, 6; Idaho, 1; Wyoming, 4; Utah, 13; Nevada (except S.W.), 0; Washington, 38; Oregon, 13; N. California, 179

Washington, D.C. . . . . **Total 273**
Delaware, 9; Maryland, 92; West Virginia, 7; Virginia, 79; D.C., 86

Treasurer's Report—

January 1–December 31, 1960

CASH			
Cash on deposit-January 1, 1960		$ 96,975	
Deposits	$490,765		
Disbursements	499,937	9,172	
Cash on deposit-December 31, 1960			$ 87,803
Petty cash fund			300
Total cash on deposit and on hand			$ 88,103
INVESTMENTS			
Savings accounts-January 1, 1960	$ 60,045		
Add: Interest credited	247	60,292	
Withdrawals		60,292	0
Custody Accounts, December 31, 1960			
U.S. Government Bonds & Bills		$ 26,641	
Fed. Nat. Mtge. & Credit Bank Bonds		75,317	
Miscellaneous Stocks		49,500	
Uninvested Principal & Income		1,321	
Total Investments			$152,779
Total Cash and Investments—December 31, 1960			240,882

Respectfully submitted, G. CARLETON HUNT, Treasurer

Statement of Income and Expenses—January 1–December 31, 1960

INCOME		
Membership dues received		$118,685
Test film operations		
Test film sales	$ 75,841	
Less: Cost of test films sold	46,778	29,063
Conventions		
Total income—registrations, banquets, etc.	27,489	
Less: Expenses	22,081	5,408
Interest and other income		4,523
Special Activities – net		10,651
Total Income		$168,330
EXPENSES		
Publications		
Cost of publishing Journal, reprints, etc.	$113,978	
Less: advertising revenue, sales to non-members, etc.	85,587	$ 28,391
Membership records and promotion		11,273
Engineering services		17,382
Administrative		85,533
Sections and Chapters		4,704
Affiliations		1,668
Non-Engineering Committees		766
Provision for 1960 5-Year Index		500
Total Expenses		150,217
Excess of Income Over Expenses		$18,113

Balance Sheet—December 31, 1960

ASSETS – GENERAL FUND				
Cash in bank				$ 87,804
Petty cash fund				300
Savings accounts				0
U.S. Government Bonds (at cost)				0
U.S. Treasury Bills (at cost)				15,680
Accounts receivable				15,986
Test film inventory				13,639
Test film equipment (nominal value)				1
Office furniture and equipment (nominal value)				1
Prepaid expenses				5,892
Total Assets – General Fund				$139,303
Reserve Fund				
Cash in Bank				1,321
Investments at Cost				135,778
Total Assets – Reserve Fund				137,099
Total Assets				$276,402
LIABILITIES AND RETAINED INCOME				
Accounts payable				8,634
Customers' advance payments				30,554
Membership dues in advance				38,818
Accrued payroll taxes				554
Accrued expenses				633
Total Liabilities				$ 79,193
Income retained for working capital and contingencies				
Reserve for replacement of test film equipment			$ 15,070	
Reserve for 5-Year Index			2,500	
Unappropriated-January 1, 1960	$161,526			
Add: Excess income over expense—1960	18,113			
	179,639			
Deduct amount transferred to Reserve Fund	137,099			
Unappropriated – December 31, 1960			$ 42,540	
Retained Income – General Fund			60,110	
Reserve Fund			137,099	
Total Retained Income				197,209
Total Liabilities and Retained Income				$276,402

Respectfully submitted, ETHAN M. STIFLE, Financial Vice-President

Accountants' Report

January 31, 1961

To the Members and Board of Governors of the
Society of Motion Picture and Television Engineers:

In our opinion, the accompanying financial statements present fairly the financial position of the Society of Motion Picture and Television Engineers at December 31, 1960, and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year. Our examination of such statements was made in accordance with generally accepted auditing standards and accordingly included such tests of the accounting records and other auditing procedures as we considered necessary in the circumstances.

SMITH & FLANAGAN
Certified Public Accountants

141 E. 44 St., New York 17

Membership Report—Year Ended December 31, 1960

	Hon.	Fel.	Act.	Assoc.	Stud.	Total Ind.	Sust.	Total
Membership, Jan. 1, 1960	10	266	2442	2889	357	5964	133	6097
New Members			202	454	66	722	6	728
Reinstatements		1	27	21	1	50		50
	10	267	2671	3364	424	6736	139	6875
Resignations		−4	−55	−69	−21	−149	−1	−150
Deceased	−3	−3	−10	−6	−1	−23		−23
Unpaid Members Removed 12/31/60		−3	−106	−189	−76	−374	−3	−377
	7	257	2500	3100	326	6190	135	6325
Transfers:								
Student to Active			+1		−1			
Student to Associate				+49	−49			
Associate to Active			+32	−32				
Active to Fellow		+14	−14					
Active to Associate			−8	+8				
Associate to Student				−1	+1			
Membership, Dec. 31, 1960	7	271	2511	3124	277	6190	135	6325

Nonmember Subscriptions: December 31, 1960 — 1911.

news and reports

Education, Industry News

The 1961 National Conference of the Society of Photographic Scientists and Engineers will be held May 22–26, at the Arlington Hotel, in Binghamton, N.Y. One of the important events will be a panel discussion on "Communication Theory in Photography," moderated by R. Clark Jones. The panel discussion is scheduled for the afternoon of May 25 (Thursday). Session topics include Color Photography (two sessions); Test Methods and Instruments; Aerial Photography, Data Acquisition, Instrumentation; Response Characteristics of Photographic Systems; and Theory and Chemistry of Photosensitive Systems. In addition to the Papers Program a Ladies Program and various social events have been planned. Registration chairman is A. F. Jennings, 32 Castle Creek Rd., Binghamton, N.Y.

The papers program of the 17th Annual National Electronics Conference, to be held October 9–11, 1961, in the International Amphitheatre, Chicago, will cover a wide range of topics, exploring almost every field of interest to electronic engineers. Space Communications, Man in Space, Learning and Adaptive Systems, Instrumentation, and Optical Communications are only a few of the disciplines and techniques to be covered in papers scheduled for presentation at the Conference. Awards of $500 each will go to the authors of the two best papers. Recipients of Awards for papers presented at the 1960 NEC are L. P. Huelsman, Univ. of Ariz., for "Active RC Synthesis With Prescribed Sensitivity," judged the best overall paper; and R. M. Lerner, Mass. Inst. Tech., author of "Modulation and Signal Selection From Digital Data Systems," judged the best tutorial paper. The Papers Program is under the guidance of W. L. Firestone, Motorola, Inc., 4501 W. Augusta Blvd., Chicago 51.

Plans for the formation of a new technical group to be organized by the Theater Equipment and Supply Manufacturers Association (TESMA) with the cooperation of this Society have been announced. Creation of the new group is for the purpose of implementing an industry-wide theater improvement program, resembling in many respects the program of the now-defunct Motion Picture Research Council (*Jour.*, p. 364, May 1960). Preliminary discussions engaged in by the SMPTE Executive Council and representatives of TESMA indicated that there would be no conflict of interests between the Society and the proposed group.

Restoration and duplication of important films to be maintained in the archives of the Hollywood Motion Picture and Television Museum will be greatly facilitated by a grant of raw stock and laboratory work contributed by Eastman Kodak Co. and Consolidate Film Industries, according to a recent announcement. Sidney Solow, Vice-President of Consolidated Film Industries, has reported an agreement with the Museum of Modern Art, New York, whereby films from the New York museum's film library will be made available to the Hollywood Museum for reprocessing and restoration. It is expected that the proffered support and cooperation will make it possible to complete much of the work of restoration and reprocessing before the opening date of the Hollywood Museum.

SMPTE in London. Display arranged by W. De Lane Lea, UK Membership Chairman, at the TV Mail World Awards Exhibition.

The first space camera to take motion pictures of the Earth from an altitude of more than 300 miles has been presented to the Smithsonian Institution, Washington, D.C. The camera, developed jointly by General Electric's Missile and Space Vehicle Department and the ACR Electronics Corporation, was presented by Hilliard W. Paige, General Manager of the GE Missile and Space Vehicle Dept., to Leonard Carmichael, Secretary of the Smithsonian Institution, during ceremonies held February 28 at the National Air Museum's Air and Space Building. The camera, structurally designed to afford maximum protection to the exposed film during re-entry, deceleration, water impact, and flotation was used in the Air Force Thor (No. 187) launched May 12, 1959, from Cape Canaveral, Fla. Fifteen minutes after the missile left the launching pad, and at the end of a flight of 1500 miles, the camera was retrieved by crew members on the recovery ship. To produce successfully a photograph of the Earth from above its atmosphere the camera was constructed to withstand a force of 40,000 g's as well as exposure to undesirable light levels and immersion in the sea.

A method of teaching science in the fourth through sixth grades by motion pictures, the idea of Albert Baez, Professor of Physics at Harvey Mudd College, Claremont, Calif., is being developed by Encyclopaedia Britannica Films, Wilmette, Ill., it has been announced by the President, Maurice B. Mitchell. A series of 15 films called the Middle Grades Physical Science Series is planned to "define basic scientific ideas in a manner not previously employed for educational films at this level. It is part of an 87-unit program of films in the field of elementary science," Mr. Mitchell stated. The films are designed so that children may be able to see demonstrations of axioms and theories that otherwise they would be required to accept on blind faith. For example, in a film on *Uniform Motion*, sports cars, rocket ships and a man fired from a cannon are used. Each film in the series ranges from 12 to 18 minutes.

A new surfacing material for projection screens has been announced by Eastman Kodak Co. The material, a film base embossed with about one million lenses, mirror or prisms per square inch and coated with a highly reflective aluminized layer, was described in a paper by Allen F. Fultz presented at the 5th Annual Technical Symposium of the Society of Photographic Instrumentation Engineers. This surfacing material is intended especially for use in military aircraft. The selectiveness of the system depends for brightness on the position of the observer, so images from separate projectors can be shown on the same screen and viewed individually by pilot and copilot from different angles.

Edgerton, Germeshausen & Grier, Inc., incorporated in 1947, made its initial public offering of common stock in July. The company has been a prime contractor to the Atomic Energy Commission since its incorporation. Its main activities have been the designing, producing and developing of electronic and nucleonic instrumentation systems.

Norelco Universal 70/35 projectors have been installed in the Mann (formerly Pan) Theatre in Minneapolis (reopened March 15 after extensive improvements), and in the North Star Drive-In, Denver, Colo. Other additions to the Minneapolis theater include a six-channel transistorized sound system and Altec-Lensing speakers installed by Northwest Sound Service. The

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Positive Films   Sound Films   Reversal Films
Gevacolor Color Films
Magnetic Films   Television Films

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In Canada: Photo Importing Agencies Ltd., 345 Adelaide Street, West, Toronto 2B, Ontario

Norelco projectors were installed by Fred J. Pfeiff, Technical Manager of North American Philips Co.

Special electronic equipment for the synchronous editing of video tape to allow fades and dissolves and other technical effects such as split screen or transition with expanding geometric patterns has been installed in the Reeves Sound Studios division of Reeves Broadcasting & Development Corp., 304 E. 44 St., New York Air bearing heads have been installed on the Studio's eight video-tape units for increased stability of the video-tape picture.

In a separate announcement Reeves reported purchase of Station WHTN-TV, Huntington-Charleston, W.Va., from Cowles Magazines and Broadcasting, Inc. This is the firm's third recently acquired TV station. The other two are stations WUSN-TV, Charleston, S.C.; and KBAK-TV Bakersfield, Calif.

An Educationa Technology and Products Project has been established by Genera Electric Co. to study and develop commercial activity in this field. Head of the project is Robert G Frick. The project will be carried on in Syracuse within GE's Technical Products Operation Staff members include Robert W. Beckwith, Manager of Engineering; William C. Schwarzbek, in charge of consultant-learning research; and George K. Mangild and Eugene L. Re, in charge of marketing research Related studies include teaching machines, language and learning laboratories, school communication systems, educational business machines, educational TV and radio equipment, and program materials and advisory services.

Conferences sponsored by the Industrial Relations Center of the California Institute of Technology, Pasadena, Calif. are: Supervision of Engineers, and Psychology for Management, each scheduled for June 18–23; and Development of Interviewing Skills, scheduled for June 25–30. The conference on Supervision of Engineers will be repeated June 25–30. Enrollment in each conference will be limited to 22. The fee per conference is $150.

Frank Lewin's song cycle *Innocence and Experience*, commissioned by the Friends of Music at Yale, was given its first performance February 18 in New Haven, by soprano Helen Boatwright with a chamber ensemble conducted by Keith Wilson to honor Yale University's annual Alumni Day. *Evocation*, a symphonic work written for the Princeton Symphony on the occasion of its Tenth Anniversary was given its first performance at the orchestra's concert on March 27 under Nicholas Harsanyi. Mr. Lewin, a composer known especially for his film and theater music, is also a motion-picture sound editor. He is the author of the SMPTE publication *The Soundtrack in Nontheatrical Motion Pictures* which was first published in installments in the March, June and July 1959 *Journals*.

A report from the American Medical Association's Film Library shows that in 1960, 479 of the library's films were used by 282 medical societies, as compared to 258 films used by 151 societies in 1959. The library now contains 1066 prints of 254 subjects, of which 725 prints of 172 medical subjects are suitable for professional audiences, and 341 prints of 82 health films are intended for lay audiences. Ninety-six per cent of all medical schools in the United States borrowed films from the library during 1960

Radio Hong Kong's new VHF/FM station, which went on the air in June, uses four Marconi 5-kw frequency modulated transmitters (Type BD321) in two parallel pairs to ensure the reliability required for unattended operation. The station, installed by Cable & Wireless Ltd. on behalf of Hong Kong Broadcasting Service, is situated at Mount Gough. The parallel pairs system was developed by Marconi's Wireless Telegraph Co. for use on remote transmitter stations, difficult of access except on foot. Two transmitters in parallel are used on each program instead of the more usual combination of a main and a lower power standby transmitter. Should one transmitter fail, the other continues to radiate the program at quarter power without the break which would occur if a standby transmitter were switched on.

At the Mount Gough station, the output of one of the two English program transmitters on 91 mc is combined with the output of one of the Chinese program transmitters on 94 mc. This combined output is then fed through a 160-ft length of $3\frac{1}{8}$-in.

coaxial feeder to one-half of the aerial. Similarly the other two transmitters are combined and fed to the other half of the aerial. In this way should any one transmitter, combining unit, feeder or aerial-half develop trouble, then quarter-power radiation is continued without interruption. The aerial is a Marconi quadrant supported by a 135-ft tower. The transmitters are switched on by clocks half an hour before the start of the programs. Two clocks are used on each program so that the failure of one clock does not affect operation. A line to the studio indicates normal operation of the transmitter.

Ampex Professional Products Co. has been reorganized to provide separate manufacturing, research and development and marketing organizations for video and audio products. The audio division has been consolidated with Ampex Audio Co., Sunnyvale, Calif. Administration will be under the supervision of Herbert L. Brown, Manager of Ampex Audio, and a Vice-President of Ampex Corp. The video products division has been formed into a new organization called Ampex Video Products Co. Manager of the new company is L. E. Good, former Manager of Ampex Professional Products Co.

The American Microwave Division of Missile Systems Corp., North Hollywood, and the Vicon Division of Insul-8-Corp., San Carlos, Calif., have been combined to form a separate company called the American Microwave and Television Corp., with headquarters in San Carlos. The new firm will specialize in the construction and installation of closed-circuit systems and microwave electronic data transmission systems. President of the new company is F. Dan Meadows.

Precision optical etching on lenses and glass is a specialty of E. Youngling, 24 Collins Rd., Glen Cove, L.I., N.Y. Mr. Youngling invites inquiries as to the availability of reticles, viewfinders, scales and optics for any purpose.

Gold Medal Studios, opened in 1956 on the site of the historic Biograph Studio, at 807 E. 175 St., New York 60, is said to be the largest motion-picture studio on the East Coast. The Studio recently announced creation of a subsidiary called Gold Medal Enterprises for the purpose of producing feature films, shorts, and television series. President of the new organization is Martin H. Poll.

A plan under which special-body trucks used in the motion-picture industry can be leased without maintenance for no less than four or more than eight years has been announced by the Truck Dept., Wheels, Inc., 6200 North Western Ave., Chicago 45. Under this plan, Wheels' engineers will engineer the bodies and chassis to the user's specifications and will deliver the trucks to points specified by the user. The plan is limited to companies with a new worth of $1 million or more and a record of profitable operations.

Ira R. Kohlman has been named Manager of Technical Services and Color Photography for LogEtronics Inc., Alexandria, Va. In this post he will be responsible for customer relations and training programs for the use of LogEtronic equipment and he will also have marketing responsibility for the application of LogEtronic equipment for color photography. Mr. Kohlman was formerly Plant Manager for Colorfax Laboratories, Silver Spring, Md. He has also held the post of Quality Control Supervisor for Pavelle Color Laboratories in New York.

Louis L. Pourciau has been appointed to the newly created position of Head of the Industrial Products Department of the Engineering Division, GPL Division, of General Precision, Inc., 63 Bedford Rd., Pleasantville, N.Y. In this position he will be responsible for television, motion-picture and medical electronic products. Two other appointments announced by GPL were those of John C. Forrest as Director and Frank N. Gillette as Associate Director of the Engineering Division. Mr. Forrest has been with GPL since 1955 and prior to his present post was Chief Engineer for Radar and Special Products. Dr. Gillete was formerly Chief Engineer for Industrial Products. He was among the original group of scientists who joined GPL in 1946. Mr. Pourciau has also been with GPL since 1946.

Henry C. Yutzy has been elected Vice-President of the Eastman Kodak Co. Formerly an Assistant Director of the Kodak Research Laboratories, he will now be a member of the company's general management and will be concerned with the general planning and coordination of the development of new and improved photographic products and related systems. He will maintain liaison in these areas between the general management of the company and its various units that conduct

photographic development programs in the United States and foreign countries. He became associated with the Kodak Research Laboratories as research chemist in 1936. He was appointed Assistant Director of the Laboratories in 1955.

Seven new appointments have been announced by Kodak Research Laboratories. John A. Leermakers has been appointed Associate Director. He has been Assistant Director since 1947. Rudolph E. Damschroder and Wesley T. Hanson, Jr., have been appointed Assistant Directors. Robert E. Stauffer has been appointed Head of the Emulsion Research Division, succeeding Dr. Damschroder. Douglas E. Piper has been appointed Associate Division Head in Emulsion Research. Paul W. Vittum has been named Head of the Color Division, succeeding Dr. Hanson. Arnold Weissberger has been named Associate Division Head.

Skipwith W. Athey has announced establishment of services as Engineering Consultant in the fields of optical and motion-picture and television analysis; visual, aural and recording systems; and technology for the theater arts. His address is Box 11,372, Station A, Palo Alto, Calif.

Harold Schroeder has been appointed head of Bausch & Lomb's newly created Optical Coating Process Department. Mr. Schroeder has been with the firm since 1943 and has recently specialized in research on vacuum coating techniques.

Robert Pell has been appointed Sales Manager of Byron Motion Pictures, Inc., Washington, D.C., where he will develop and direct an expanded national sales program. Prior to his present appointment he was an account supervisor with Music Makers, Inc., New York.

Jack West has been appointed Manager of General Film Laboratories Central Division, Kansas City, Mo.. succeeding Neal Keehn, who has been appointed Vice-President in charge of sales, and transferred to the home office in Hollywood where he will coordinate and supervise sales activities. In his new post, Mr. West will be in charge of the firm's sales and services to motion-picture producers East of the Rockies. Prior to his present appointment he was Producer Services Manager for the Central Division.

Encyclopaedia Britannica Films Inc., 1150 Wilmette Ave., Wilmette, Ill., has announced the formation of three new departments for distribution of specific types of material. TEMAC is a new division to handle the distribution of Programmed Learning Materials in high school and college mathematics and modern foreign languages. Raymond Kroggel, Vice-President, is Director of the new division. Head of the EBF Film Division is Ralph Wagner. Films Inc. is a subsidiary that handles rentals of 16mm entertainment films. Director of Distribution is Michael R. Nuzzola.

The Joint Council on Educational Television (JCET) has changed its name to the Joint Council on Educational Broadcasting (JCEB) to reflect the organization's broadened interests in the educational use of both TV and radio. Cyril M. Braun, former Engineering Consultant to JCET has been appointed Engineering Consultant to the newly named organization, with headquarters at the National Educational Television and Radio Center, 1785 Massachusetts Ave., N.W., Washington 6, D.C. Secretary of the expanded organization and Director of the Center is David C. Stewart.

George F. Houlroyd has been elected Vice-President of Manufacturing of Foto-Video Electronics, Inc., 36 Commerce Rd., N.J. He has been with the firm since 1959 in the capacity of Plant Manager. He has been active in the electronics equipment industry since 1927 when he joined the staff of Hardwick-Hindle, Inc., as foreman of resistor manufacturing.

Two new appointments have been announced by On Film, Inc., Princeton, N.J. Norton T. Gretzler has been appointed Television Commercial Coordinator and Joseph A. Fiorelli has joined the staff as Producer. Mr. Gretzler has a background of advertising agency experience combined with television production. Mr. Fiorelli has had a wide background in art and art education and has been writer, producer and editor of two educational films.

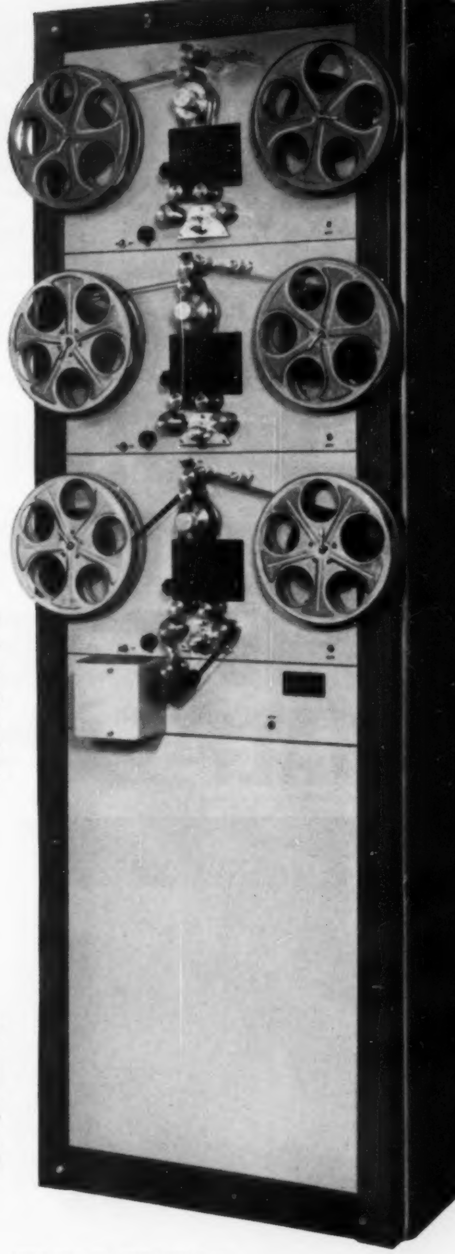
MAGNA-TECH ELECTRONIC 400 SERIES FILM RECORDING EQUIPMENT ARE VARIOUS INSTRUMENTS SPECIALIZED TO PERFORM THE FUNCTIONS ASSOCIATED WITH THE PRODUCTION OF OPTICAL AND MAGNETIC SOUND FOR MOTION PICTURES. THEY OFFER SPACE AND CAPITAL INVESTMENT SAVING WITHOUT COMPROMISING THE CRITICAL DEMANDS OF THE ENGINEER.

The transport is a self-driven unit *incorporating the film pulling mechanism, a miniaturized semi-conductor reproduce amplifier, drive motor and torque motors in one assembly. Basically a magnetic reproducer, it is also used as a magnetic recorder, optical reproducer, and optical recorder by means of optional attachments.*

A cabinet can be supplied to *house five complete film reproducers or various optional attachments and transports utilizing the 77" panel space. A semi-conductor power supply mounts inside this cabinet.*

Interlock is provided by the *conventional method using a selsyn motor mounted on each film transport. 2 to 8 track reproducers and record attachments are also provided. 8 reproduce amplifiers are mounted on one panel. Recording amplifiers are on individual panels.*

Because of quality materials, *quality workmanship, and integrity of design, together with the performance and stability, the Series 400 has a complete range of application in every phase of production of sound for films.*



VIEW OF THREE SERIES 400, TYPE MD497 DUAL FILM WIDTH, 17½mm AND 35mm MAGNETIC REPRODUCERS, AND ONE OD435, 35mm OPTICAL REPRODUCER ATTACHMENT INSTALLED IN THE CS400 CABINET.

WRITE FOR 12 PAGE BROCHURE

TYPE	FILM WIDTHS	SPEEDS(fpm)	OPTIONAL ATTACHMENTS ACCOMMODATED		
MD416	16mm	36	MR416 MAGNETIC RECORD	OD416 OPTICAL DUBBER	OR416 OPTICAL RECORD
MD417	17½mm	90	MR417 MAGNETIC RECORD		
MD435	35mm	90	MR435 MAGNETIC RECORD	OD435 OPTICAL DUBBER	OR435 OPTICAL RECORD
MD447	17½mm	45	MR447 MAGNETIC RECORD		
MD437	COMB. 17½/35mm	DUAL 45/90	MR437 MAGNETIC RECORD	OD435 OPTICAL DUBBER	OR435 OPTICAL RECORD
MD427	17½mm	DUAL 45/90	MR427 MAGNETIC RECORD		
MD497	COMB. 17½/35mm	90	MR437 MAGNETIC RECORD	OD435 OPTICAL DUBBER	OR435 OPTICAL RECORD
MD436	COMB. 16/35mm	DUAL 36/90	MR436 MAGNETIC RECORD	OD416 AND OD435	OR416 AND OR435

M.T.E. MAGNA-TECH ELECTRONIC CO. INC.
630 9TH AVE. N.Y. 36, N.Y.

Books, Booklets and Brochures

A new department for the production of films for TV has been announced by the Swiss firm Eima-films. Production of 39 telefilms is planned for 1961. The new department is described in an 8-page illustrated brochure (English edition) available from the Public Relations Dept., Eima-films, 19 Croix d'Or, Geneva, Switzerland.

Some Considerations for the Prospective Ethnographic Cinematographer, by John T. and Patricia J. Hitchcock, reprinted from the August 1960 issue of *American Anthropologist* (pp. 656–674) is an extremely practical and detailed guide for the anthropologist or social scientist planning to bring back filmic records, perhaps from the steaming jungles of Yucatan or the cold white pastures of the Arctic or Antarctic. Anthony R. Michaelis, a producer of research films, is quoted as saying, "No anthropologist would consider the undertaking of field work among a distant tribe of natives unless he had prepared himself by years of studying the theoretical and practical methods and techniques of his science . . . and yet, few have considered cinematography as one of the research techniques of collection which, like any other research technique must be learned, practised and perfected before it can yield the best possible results."

The article includes comparisons of cameras and films, and other equipments in terms of suitability for environmental conditions likely to be encountered, type of film record or documentary planned for, and price. Since many anthropologists have only a limited budget for research projects, getting the best results from camera and film while staying within budget limitations is an extremely important consideration. The authors consulted a number of top manufacturers of photographic equipment as well as producers in preparing the material for this article.

A Short Annotated Bibliography on Rapid Processing (22 pp.) contains references to selected papers published from 1935 through 1960 on the subject of rapid processing of silver halide film and papers. An Eastman Kodak publication, selections for the bibliography were made from an extensive list of references accumulated by members of the Kodak Research Laboratories. References included in the bibliography are limited to papers and other material dealing specifically with the subject. Nineteen of the 80 references are to papers published in the *SMPTE Journal*. Other references are distributed among some 20 scientific and technical journals, with one reference to a manuscript, one to a technical note, four to U.S. Patents and two to Belgian Patents.

The bibliography is available without charge from the Special Sensitized Products Sales Div., Eastman Kodak Co., 343 State St., Rochester 4, N.Y. if request is made upon appropriate company stationery.

The American Standard Acoustical Terminology (including Mechanical Shock and Vibration), Sl.1-1960, (sponsored by the Acoustical Society of America) contains nearly 600 definitions of terms used in the field of acoustics. The 62-page Standard contains five tables, a diagram (showing elements of sonar background noise), and an extensive Index. The terms are grouped under 13 Sections: 1. General; 2. Levels; 3. Oscillation, Vibration and Shock; 4. Transmission — Propagation; 5. Complex Parameters of Linear Systems; 6. Transducers and Instruments; 7. Transducer Parameters; 8. Recording and Reproducing; 9. Underwater Sound; 10. Sonics; 11. Architectural Acoustics; 12. Hearing and Speech; 13. Music. Sections 14 and 15 are on "Acoustical Units" and "Revision of American Standards Referred to in This Document," respectively. A revision of Z24.1-1951, this Standard was approved May 25, 1960. Committee members engaged in the work of revision represented more than 40 governmental groups and scientific organizations. The publication is available from American Standards Association, Inc., 10 E. 40 St., New York 16. It is priced at $4.50.

The newly revised **Radio and Television: A Selected Bibliography** is a publication of the Office of Education, U.S. Department of Health, Education and Welfare.

The 46-page pamphlet includes references to books and periodicals containing reports and discussions on research and experimentation, significant contributions to the educational applications of media materials, programming and broadcasting, and related subjects. A limited number of technical books are listed. Names of organizations and groups from which informational material is obtainable are listed. The booklet is priced at 25 cents and may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D.C.

Graflex Audiovisual Digest is a 48-page paper-bound booklet, published (1960) by Graflex, Inc., 3750 Monroe Ave., Rochester 3, N.Y. Directed mainly to teachers, the booklet contains reprints of certain articles, plus digests of others, that have appeared in professional educational publications. Practical, "how-to" articles are included along with discussions of theory. The booklet, available from the publisher, is priced at 25 cents.

Outdoor projection of giant images is described in an 8-page illustrated brochure, No. 240-B, available without charge from Genarco Inc., 97–04 Sutphin Blvd., Jamaica 35, N.Y. The brochure explains how colored images six or seven feet wide can be projected at night, and in daytime under special conditions, on white walls or through translucent screens with Genarco Slide Projectors.

8mm in Teaching Motion-Picture Production (Kodak Pamphlet No. T-11) stresses the advantages of the use of 8mm cameras in the teaching of motion-picture courses. The 4-page pamphlet stresses economy and also the simplicity of operation of 8mm cameras. It is available without charge from the Sales Service Division, Eastman Kodak Co., Rochester 4, N.Y.

Photographic processing and recording equipment is described in a four-page illustrated brochure, available from Kelvin & Hughes America Corp., Box 1951, Annapolis, Md. The brochure describes Continuous Film Processors Type RP1 and Step-by-Step Film Processors Type RP3. The latter has recently been made available in 16mm. This type of film processor is used for large bright-screen presentation of discrete displays normally appearing on a cathode-ray tube. The equipment is used to photograph the image on the tube, transport the film to the jet-spray processing stage and then transport the film to the projection station.

The Wollensak News Letter, a sheet describing new optical, optical-electrical, and optical-mechanical products, is available without charge from Wollensak Optical Co., Rochester 21, N.Y. A recent News Letter describes lenses developed specifically for underwater use, a xenon lamp system, a tripod for high-speed cameras, and outlines a report on a test of rotating prism cameras.

New information on **seven lamp types** has been issued by the Photolamp Division of Sylvania Lighting Products, Sylvania Electric Products Inc., Dept. CSP, 60 Boston St., Salem, Mass., to supersede six sheets in the Sylvania Photolamp Technical Manual. One lamp type, the 1M12TF, is no longer produced. Improvements in six types are described in the new data sheets, available upon request.

Rear Projection of Slides in Large Meetings, a 4-page brochure (#313), explains the advantages of rear projection and offers suggestions on the selection of rear-projection equipment. The brochure is available without charge from Genarco Inc., 97–04 Sutphin Blvd., Jamaica 35, N.Y.

A Collection of Tables and Nomograms for the Processing of Observations Made on Artificial Earth Satellites, by I. D. Zhongolovich and V. M. Amelin, is being published by Pergamon Press, Inc., 122 E. 55 St., New York 22. The collection is designed to facilitate work connected with the compilation of ephemerides and with the processing of observations made on artificial Earth satellites. The book is planned especially for aeronautical scientists, astronomers and engineers. It is to be priced at about $15.

Blak-Ray is described in an illustrated brochure in color, showing various uses of this fluorescent vinyl latex paint, made by Ultra-Violet Products, Inc., 5114 Walnut Grove Ave., San Gabriel, Calif. The paints are available in "visible" colors which show their true colors in ordinary light and are fluorescent in black light; and "invisible" colors which appear white in ordinary light and show their "true" fluorescent colors in black light. The latter type of paint has been found useful for various theatrical effects in costumes and background.

The Traid Line for '61, a 40-page illustrated catalog and price list, is available without charge from Traid Corp., 17136 Ventura Blvd., Encino, Calif. More than 40 items, selected as representative of cameras and equipments available from the firm are described. In addition to acting as distributor for Bell & Howell, Consolidated Systems Corp., Pacific Optical, Photo-Sonics, Neyhart Enterprises, Vanguard Instrument Corp., and Maier-Hancock, the firm also engages in research and development programs and has been active in the photographic instrumentation field for about 15 years.

The Broadcast Terminal Equipment Catalog (3d ed.), published (1960) by the Radio Corp. of America, Broadcast & Television Division, Camden, N.J., is a 144-page catalog containing detailed descriptions, specifications, illustrations and diagrams. The Table of Contents includes Custom Equipment; Switching Equipment; Special Effects; Intercom Equipment; Monitors; Amplifiers; Generators; Power

The model that won the West...

Actually, the HFC Professional 16MM Hot Splicer didn't win the West in the sense that the Colt won the West, but it did win the praises of film editors not only in the West but around the world. Professional editors who demand professional equipment. Model shown: FS-816 (for 8 and 16mm). Other models available . . . FS-70-1 (for type #1 Military perforations) • FS-70-2 (for type #2 Military perforations) • FS-70-3 (for 65MM) • FSC-357 (combination splicer, 35 or 70MM) • FSC-657 (combination splicer, 16-35/32-65 or 70MM). All models ready for immediate delivery.

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DOUBLE SCRAPING • LOSE ONLY HALF A FRAME • SEPARATE PROFESSIONAL SCRAPING BLOCK • LEFT TO RIGHT OR RIGHT TO LEFT SPLICING • MACHINE BLADES GROUND TO CLOSE TOLERANCES • NO DOWN TIME WHEN SCRAPING BLADES BECOME DULL • CHANGE BLADES IN SECONDS • CUSTOM BUILT CARRYING CASE • SPLICERS CAN BE SET FOR NEGATIVE, A & B OR RELEASE PRINTS • CUTTER BLADES CAN BE GROUND AND SHARPENED WITHOUT CHANGING SPLICE WIDTH • CUSTOM BUILT CASE

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Supplies; Racks and Mountings; and Microwave Relay. The catalog is priced at $1.00.

Two brochures describing the miniature Bolsey 8 are available without charge from Bolsey Research and Development Division of Bolsey Corp. of America, 11 W. 57 St., New York 19. This minute motion-picture camera is 3 in. high and weighs 12 oz. The booklets give step-by-step instructions for the use of the camera and describe various accessories that are available.

Prologue to Space is the theme of the September, 1960, issue of the Bell Telephone Laboratories publication *Reporter*. A particularly impressive photograph on the front cover shows the horn antenna at Holmdale, N.J., and white diagonal lines across the night sky that are "star tracks" on time exposure. An article by Frederick R. Kappel on "Communications in the Space Age," explores the practical problems of world-wide communications. James B. Fisk, President of Bell Telephone Laboratories, wrote on "Problems and Progress in Space," presenting excerpts from an analysis of space telephony prepared for the Federal Communications Commission. Other articles by scientists in the field discussed various aspects of research and development leading to space communications.

new products (and developments)

Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products or services.

The Spectra-Pritchard Photometer is manufactured and distributed exclusively by Photo Research Corp., 837 No. Cahuenga Blvd., Hollywood 38, according to a recent announcement. Measurement by the photometer of a wide range of brightness is possible because of seven electrical ranges plus seven neutral attenuation ranges. Partly polarized light is measured as well as unpolarized light because of the absence of reflecting surfaces in the measuring beam. The instrument has a telescopic viewing system reflected from the aperture mirror and a folding mirror with a straight-through optical system for sensitivity to light of any type of polarization. The objective lens can be moved to adjust the focus from 3 ft to infinity without affecting calibration of the instrument. The field-of-view of the photometer can be varied by the insertion of various mirror-apertures.

A miniature radar and television display device, developed by Westinghouse Electric Corp., Box 2278, Pittsburgh 30, Pa., has been nicknamed the Private Eye because its display can be viewed by but one person at a time. Its essential element is a cathode-ray tube seven inches long and a screen 0.60 in. in diameter seen through a magnifying eyepiece. Because of the tenfold enlargement the effect to the observer peering through the eyepiece is that of a picture on a 6-in. screen seen from a distance of 10 in. The screen is aluminized and cathephoretically deposited to insure high resolution, reported as 900 lines resolution in the present design. The tube, a WX 4527, is electrostatically focused and magnetically deflected with a deflection angle of about 34°. Suggested applications include closed-circuit systems for automobile traffic control; construction projects; military use; and three-dimensional display systems for medical and biological microscopy. A major use is expected to be

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as the display device for radar installations in private aircraft and boats. The cost is expected to be about $150 when in quantity production.

A pulsed x-ray system developed to make cineradiographs of high-speed phenomena in one microsecond, or less, has been announced by Zenith Radio Research Corp., 4040 Campbell Ave., Menlo Park, Calif. The system includes an oxide-coated thermionic hot cathode x-ray tube capable of conducting high currents at high voltage with fast rise time characteristics. Tests have shown the tube to perform consistently in reproducibility of pulse length, voltage, current, and x-ray output characteristics after approximately a million shots. The pulsed system consists of two units, the x-ray console with the x-ray generating tube, power supply and control circuits, and the image intensifier console. The x-ray tube is pulsed with a square-wave voltage pulse 1 μsec in duration, with the rate of application continuously variable from 1 to 30 pulses/sec. The high-powered, short pulses of x-radiation are passed through the subject under study and impinge on the x-ray-sensitive screen of the Rauland image intensifier tube housed in the image intensifier console. The Rauland tube amplifies the image and converts it to visible light which appears as a bright image on the tube's output phosphor. The image is suitable for direct viewing, closed-circuit, or for pickup by a motion-picture camera. The system is expected to have application in the fields of shock and vibration studies, radiation effects, rocketry, medical radiology, ballistics, and crystallography. Price range is from $40,000 to $50,000.

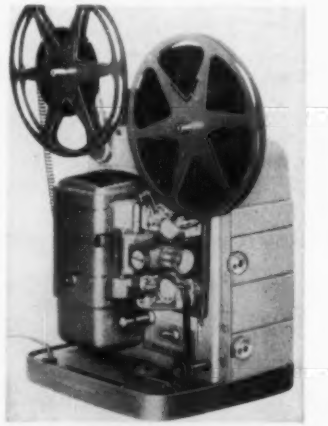
The television system for Stratoscope II — the balloon telescope now under construction at Princeton University — is based on a supersensitive image orthicon developed jointly by RCA Laboratories and RCA Electron Tube Division. Project Stratoscope II is sponsored jointly by the Office of Naval Research and the National Science Foundation. The television development is supported by the National Aeronautics and Space Administration. The television complex, to be provided by RCA, will be used by astronomers in studying such phenomena as the divisions in Saturn's rings, the sudden atmospheric changes that take place on Jupiter and Venus, and the gaseous nebulae from which new stars are formed.

Two specially developed transistorized cameras, each weighing about 58 lb, will be mounted on the telescope assembly suspended from the balloon. One of the cameras, equipped with a wide-angle lens, will look directly out into space. Scanning an area extending across 10° of the sky, it will transmit to the ground a large-area picture to be used by astronomers in selecting their targets for detailed viewing through the telescope. The second camera will be positioned to look through the telescope to show the astronomers what the instrument is seeing. During tests the cameras picked up and transmitted images of eighth-magnitude stars. (The human eye can rarely see any object fainter than a sixty-magnitude star.) The new cameras are also equipped with remote controls.

The VST-1, a VHF-to-VHF translator for extending TV station coverage areas beyond distance and terrain barriers, is produced by Adler Electronics, Inc., One LeFevre Lane, New Rochelle, N. Y. The equipment is designed for unattended off-air pickup and features operation on any VHF channel. It has 1-w output, heterodyne conversion, remote control, and use of standard VHF receiving and transmitting antennas. It is priced at $2100.

A simplified TV tape recorder, designed for use in educational, industrial military and other closed-circuit systems, has been announced by RCA. The new model has been designed with the aim of bringing video-tape recording equipment within the economic reach of a broad range of the users of closed-circuit systems. The price is expected to be about $25,000, or approximately half that of presently available RCA black-and-white TV tape recorders, now priced at $49,500.

Two electric eye zoom cameras, both 8mm roll-film models (310 and 312) have been announced by Bell & Howell. Designed for completely automatic operation, both cameras have a single speed and a universal lens which does not require focusing. Eleven-element zoom lenses ($f/2.3$ for the 310, $f/1.8$ for the 312) zoom from 9.7mm for wide-angle shots to 29.2mm for telephoto. Two filters, a haze filter to screen out ultraviolet rays, and a Type A filter to permit use of indoor film out-of-doors are incorporated in the 312. The 310 is priced at about $99.95 and the 312 is priced at about $129.95.



An 8mm projector, the Auto Load 245 was also announced by Bell & Howell. The new projector features fast, automatic film threading, a loop setter to restore a lost film loop without stopping the movie; a $f/1.6$ projection lens; and a T-12 Tru-Flector line voltage 150-w projection lamp. It is priced at about $99.95.

An improved (1961) model of the RCA TV tape recorder has been announced by the Radio Corp of America. Improved features include a transistor signal processing amplifier for finger-tip control of picture quality. Key functions such as video level, sync level and pedestal are grouped

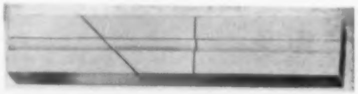
on a control panel readily accessible to the operator. The new model also has increased limiting (more than 55 db) of the demodulator to minimize tape "dropouts," and thus extend the life of the tape. The design has been made to permit more expeditious conversion to color by adding half a rack of color-handling equipment.

Two new lenses, the Wollensak 20-60mm $f/1.8$ Vari-focus lens "C" mount for 16mm cameras, and its 28–75mm $f/2.3$ companion for Fastax, the WF-220, have been announced by Wollensak Optical Co., Rochester 21, N.Y. The lenses are priced at $298, and $345, respectively. The firm has also announced an improved model of the WF-142 13mm $f/1.6$ Fastax Raptar Wide Angle, which is now available in a focusing jacket. The improved lens is designed for critical focusing. It is priced at $275.

Two 8mm projectors and a slide projector have been announced by Ansco, Binghamton, N.Y., A Division of General Aniline and Film Corp. The Memo Master Projector features a 13mm to 25mm focal length zoom lens, to allow the operator to enlarge the picture on the screen to four times its original size without moving the projector. A rheostat knob controls speed-up or slow-down continuously. Reverse action setting on the master control knob permits reviewing of any desired scenes. The price is under $90. The Memo 80 Projector features a new light system and a high-efficiency $f/1.6$ projection lens. The price is under $65. The Anscomatic Slide Changer can be operated by automatic control or manually. It accommodates any type or size of slides up to $2\frac{1}{4}$ sq in. It is priced at $119.50.

A 16mm silent projector with a 2000-ft reel capacity has been anounced by Victor Animatograph Corp., Division of Kalart, Plainville, Conn. Designed primarily for use by coaches and time-study engineers, the projector has a remote control forward- and reverse switch and a rheostat control for forward operation within a range of 10 frames/sec to 27 frames/sec. The machine runs in reverse at a rate of $18\frac{1}{2}$ frames/sec. A special optical system with heat filters is incorporated to enhance projection of still pictures. The machine also is equipped with a safety film trip for stopping the machine automatically in a film emergency, thus preventing film damage.

Protect-a-Print, a special film base designed to be run through cameras to prevent scratching of the film due to dirt and emulsion accumulation, a product of Flight Research, Inc., P.O. Box 1-F, Richmond 1, Va., has been made available in 100-ft lengths, according to a recent announcement. The new length is designed to meet the specialized requirements of testing centers where many remotely located cameras are in operation at one time. The 100-ft rolls are available for 16mm double perforation at a base price of $16.50 per roll and for 35mm standard at a base price of $24.75. The film base continues to be available in 400-ft packages for 16mm and 35mm and 200-ft packs for 70mm.



The Editall Block (the S2), designed especially for attachment to modern compact tape recorders, has been announced by the Tall Company, which recently opened new offices at 27 E. 37 St., New York 16. The block is 4 in. long, $\frac{3}{4}$ in. wide and $\frac{1}{4}$ in. thick. It is priced at $6.50. The new block is also available in a package containing a china-marking pencil for marking tape, a roll of $\frac{7}{32}$ splicing tape and an instruction book condensed from the chapter on "Editing," in *Techniques of Magnetic Recording*, by Joel Tall. In addition to the new block, the firm produces editing blocks for all sizes of magnetic tapes from $\frac{1}{4}$ in. to 1 in.

A work table particularly adapted to use in the motion-picture industry is a product of Swaptops, Manchester, N.H. Designated the GP-100, it is manufactured by the Leitch-Huard Corp., Manchester, N.H. The table has an interchangeable top and table and is designed with a rigid frame that is virtually free of dust traps.

Magnetic tape for business, home and laboratory use is a newly developed product of Burgess Battery Co., Division of Servel, Inc., Freeport, Ill., and a separate Magnetic Tape Division has been established within the firm to handle production and marketing of the new audio tape. The firm is continuing developmental work on magnetic tape for electronic data processing systems and for expanding video-tape applications. In manufacturing the new tape, available in $\frac{1}{4}$-in. widths, a special acicular iron oxide powder, filtered down to a particle size of 5 microns, or less, is used. The needle-shaped particles are then dispersed by a new process that separates the particles without shattering them. Acetate or Mylar plastic is used as the base, precoated to eliminate imperfections. Application of the magnetic coating is made in a dust-free room, and a "static" coating process has been developed to eliminate the possibility of any dust particles adhering to the finished coat.

Products announced by Pro-Tex Reel Band Co., 200 Film Bldg., Cleveland 14, Ohio, include a nonmagnetic reel clip that snaps over the reel flange to keep the tape from loosening and unwinding; a packaged tape reel called Sealedreel, to seal tape and film from extremes in humidity and from dust; and Friction Free Tape Reel

or smooth, tight winding of tape. The tape reel features specially designed embossing to eliminate "flat spots" and portions of loose winding.

Two transistorized television projection systems have been introduced by Giantview Television Network, 1280 Fifth Ave., New York 29. The two systems (1014-Portable and 1014-R Permanent are described in a brochure available from the firm's New York offices, or from 901 Livernois Ave., Ferndale 20, Mich. Both models provide a complete system for closed-circuit or "off-the air" VHF and UHF projection. Only one operator is required. Both models feature a separate remote light unit that can be operated up to 200 ft.

A new series of closed-circuit TV monitors has been developed by General Electric for visual communications systems. In designing the new series emphasis was placed on accessibility to parts. Either side of the cabinet can be easily removed to expose parts for simple maintenance. Wiring and components are accessible through removal of the bottom cover panel. The picture tube face and glass faceplate are also easily accessible for cleaning. The monitors are available in three screen sizes, 14, 17 and 21-in., as announced by GE Communication Products Dept., P.O. Box 4197, Lynchburg, Va.

A new instrumentation recorder/reproducer, the G-100, and an improved model of the CM-100 video band recorder/reproducer have been announced by Minnesota Mining and Mfg. Co., Minicom Div., 2049 S. Barrington Ave., Los Angeles 25. Bandwidth of the CM-100 (used for predetection recording) has been extended to 1.2 mc, a 20% increase over its former capability of 1.0 mc. Increase is proportionate at all six speeds. An additional improvement has been made so that the standard one-rack, seven-track model may be easily converted to 14 tracks. This is accomplished by plugging in an additional rack of electronics, slightly changing the tape transport so that it will accommodate 14 tracks of information on 1-in. tape. The same

overall bandwidth of 400 cycles to 1.2 mc can be achieved simultaneously on all 14 tracks. Constant phase-equalization at all six speeds provides maximum fidelity of recorded data and playback speeds can be reduced by a ratio of 16 to 1.

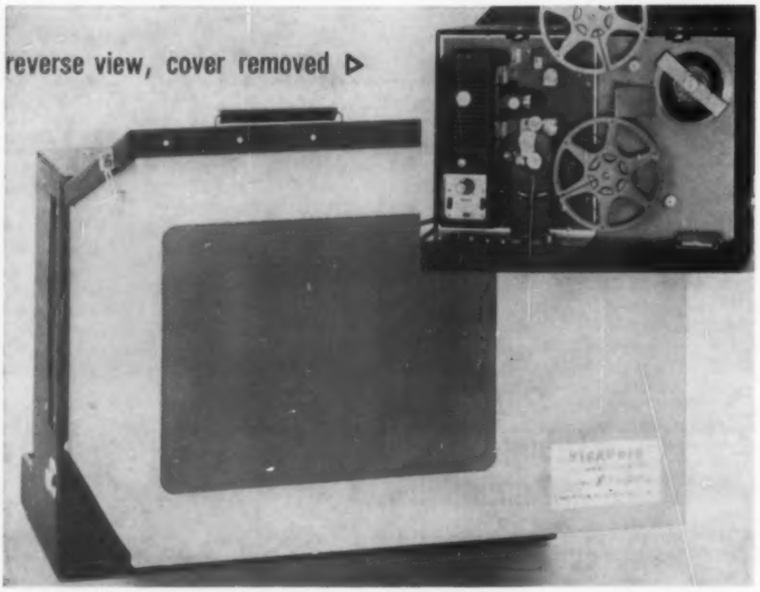
Two miniature light sources, blinking on and off at rates up to 1500 cycles/sec provide the driving force in a microvolt modulator announced by Apollo Electronics, Inc., 301 S. Harbor Blvd., Fullerton Calif. Two light sources, driven by an internal oscillator circuit and set to operate at 50, 400, 1000 or 1500 cycles/sec, project onto two photoelectric elements. These in turn convert the input signal, either d-c or low-frequency a-c, into a full wave modulated output. The unit weighs about 3.3 oz, and is enclosed in an aluminum container 1 in. in diameter and 2¼ in. long. Pin connections fit into standard 7-pin miniature tube sockets. Input and sync outputs are at the top of the device and the signal connections are at the base.

A pushbutton switch, measuring 1¾ in. in length and occupying less than 1 in. behind the panel is a product of Pepco Inc., 2080 Placentia Ave., Costa Mesa, Calif. The switches may be used individually or in interlocked, ganged groups. Silver alloy contacts are used to provide operations of over 100,000 cycles at rated load. For low-level switching applications, the switch is available with gold-plated contacts. The unit may also be provided with "O" rings and a diaphragm seal.

RF filters equipped with special fittings to accept any of the common subminiature connectors have been announced by Telonic Engineering Co., Laguna Beach, Calif. The units, available in band-pass or low-pass types, are designed for use in missiles, ground support systems, and telemetering equipment where space requirements and weight are critical. The basic filters are the Telonic TBP and TLP series with adapter fittings attached to both ends.

A seven-pin coaxial connector, designed to meet military specifications, has been developed by Viking Industries, Inc., 21343 Roscoe Blvd., Canoga Park, Calif., for use by electronic, aircraft and missile industries. The connector features individual, coaxial, snap-in contacts that can be removed from the connector with an extraction tool. The contacts utilize a clamping mechanism to retain both the coaxial cable jacketing and the braid. The mechanism will retain the coaxial cable with a minimum of 15-lb force and is designed to retain four cable sizes. The coaxial contact material is copper alloy, rhodium plated. Inner insulation material of the coaxial contact is Teflon.

An electronic device for clinical use in recording pupillary movement has been announced by GPL Division, General Precision, Inc., 63 Bedford Rd., Pleasantville, N.Y. The device, called an Electronic Pupillograph, is a direct writing instrument used to detect pathological processes within the nervous centers and pathways of pupillary control.



The Vicaudio Mark I, a portable 8mm sound motion-picture projector with a self-contained rear projection screen, has been announced by Vicom, Inc., 70 Aberthaw Rd., Rochester, N.Y. Designed by Fred E. Aufhauser, the unit incorporates the Kodak Sound 8 Projector together with the Vicom optical system to achieve 500× magnification. The projector is designed for use in lighted areas such as shop windows, counters, offices and exhibits, as well as for classrooms and industrial applications. The unit includes a continuous reel up to 400 ft. Larger reels are available to provide up to 40 minutes of continuous projection. The projector is priced at $495.00 for a single unit.

Development of a specially processed gray insulation coating (rather than the usual white coating) for heater wires of receiving tubes has been developed by the Electron Tube Division of RCA. The so-called "dark heater" operates at temperatures down to 350 K below the 1500 to 1700 K of the white heater. Beneficial results of use of the "dark heater" are reported as lower internal stresses in the heater wire and smaller thermal change during the heater cycling, which tend to lessen possible recrystallization and burnout. The "dark heater" is said to have stable current characteristics which contribute to the maintenance of a constant cathode temperature.

Beaded leads and glass seal subassemblies used in the manufacture of glass diodes are products of Electronic Glass and Ceramic Corp., Cambridge, Mass, a Division of Alloys Unlimited, Inc., 21-01 43d Ave., Long Island City 1, N.Y. Both moly and dumet studs with hard glass packages are available. The subassemblies are being produced to fit specifications of individual diode manufacturers.

A superconducting compound of niobium and tin (Nb_3Sn) (which becomes superconducting at 18 K) has been used by research scientists at Bell Telephone Laboratories in experiments demonstrating the feasibility of superconducting solenoid magnets producing extremely high magnetic fields. Special metallurgical techniques were employed in constructing a solenoid using the niobium-tin compound. Indications are that the new compound will sustain steady-state magnetic fields of 100,000 gauss while carrying 100,000 amp/sq cm of cross-section. One of the important attributes of the superconducting solenoid is that it does not require expenditure of electric energy once the field is established. It has been suggested that the development of traveling wave tubes and masers may be influenced by this discovery. The availability of large magnetic fields can extend the operation of these devices to higher frequencies, thus providing the possibility of broadband communication systems for use by Earth-based radio-relay systems and active satellite repeaters for space communications.

employment service

These notices are published for the service of the membership and the field. They are inserted three months, at no charge to the member. The Society's address cannot be used for replies.

Positions Wanted

Film Production Administrator. 24 yrs experience in industrial motion-picture and general photography production. Technical background in most crafts; writer and director-cameraman. Until recently vice-president in charge of sales for production company in New York; familiar with government contracts and security problems. Currently free lancing but wish to settle down again; will relocate. Dermid Maclean, 8 Cameron Rd., Tenafly, N.J.

Cameraman-Director, 40, Class "A" IATSE New York, seeks interesting, challenging assignment or top position. 19 yrs production work in studio and on locations all over Europe, Asia and Africa. Producer for U.S. Government; experienced in studio and production center organization, training of technical staff, supervision of film editing and completion. Technical consultant, familiar with most U.S. and foreign equipment. Fluent German, French, some others. Writing credits; internatl. film award. Prefer educational and documentary field, also highly technical training and industrial films. Shooting all types of productions; flawless and imaginative coverage on any subject, anywhere. Permanent relocation possible. Cinematographer, 92 Park Hill, Massapequa, L.I., N.Y. LI 1-9487.

Cameraman-Editor. Since 1935 active in production of documentaries, television commercials, educational, industrial and progress report films, can handle both 35mm and 16mm black-and-white as well as color. Wants steady work or assignments, anywhere. Can edit A and B rolls, and write own scripts. Modest fee. Will send resume on request. Henrick N. Weener, 1215 Cabrillo Ave., Venice, Calif. EX 9-5692.

Motion-Picture Editor and Cameraman. Presently with a multicam film project at Univ. of Ill. as Head Editor and Head Cameraman. Formerly with N.O.T.S. China Lake as Cameraman and Editor. B.A. and part M.A. from Univ. of Southern Calif., Dept. of Cinema. Also experienced in teaching basic cinema, motion-picture laboratory, still work, and other aspects of film production. Interested in a challenging position with potential. Write for resume or Form 57; Stanley Follis, 908 W. Maple St., Champaign, Ill.

Positions Available

Film Production Aide. The New York State Department of Civil Service will conduct an examination for Film Production Aide on April 29, 1961. Salary $3500 to $4350 in five annual increases. Open only to New York State residents. A Film Production Aide assists in preparations for shooting of motion picture film. Requires one year of paid experience in motion picture or television work and either one year of experience in operation of motion picture projector or one year of training in photography or television production or equivalent training and experience. For details contact the Recruitment Unit, Box 84-A, New York State Department of Civil Service, The State Campus, Albany 1, N.Y.

Soundman. Motion-picture recording studio requires alert soundman for staff. Must know all phases of sound recording including RCA equipment. Send resume to 446 East 86 St., Att: Monahan, Rm. 6-C, New York 27.

Film Processor. Motion-picture recording studio requires man for developing film in laboratory. Experience. Permanent. Write particulars to Mrs. M. Monahan, 446 East 86 St., Rm 6-C, New York 28.

Motion Picture Sound Engineer. Experienced in recording motion picture soundtracks, transferring and mixing. Familiar with design and circuits of professional equipment. Desire to work for religious film unit. Write for application to TRAFCO of The Methodist Church, c/o Duane Muir, 1525 McGavock St., Nashville 3, Tenn.

Closed-Circuit TV Technician or Engineer. Experienced. Must be familiar with all phases of closed-circuit television systems. To work with Chief Engineer of West's largest producer of CCTV equipment. L. G. Schlicht, 1920 So. Figueroa St., Los Angeles 7, Calif. Richmond 8-2852.

16mm Film Editor, permanent staff, experienced, possibility of some directing. Church related film unit, with studio in Nashville, Tenn. Productions include dramatic, documentary and panels. Write TRAFCO of The Methodist Church for application, c/o Duane Muir, 1525 McGavock St., Nashville 3, Tenn.

Engineer. Position for individual with degree in Industrial Engineering, Photography or related field. Experience with motion-picture laboratory or data-processing equipment essential. This position is located in Florida. If interested, please forward resume to W. F. Marquette, RCA Employment Office, Patrick AFB, Florida.

Aero-Space Technology. Positions with National Aeronautics and Space Administration, Washington or other installations, from $5335 to $21,000 a yr. For applications and information on positions in physical sciences, engineering and mathematics; life sciences and systems; or research & development administration; write to Board of U.S. Civil Service Examiners, NASA, at any of the following Centers: Ames Research Center, Mountain View, Calif.; Flight Research Center, P.O. Box 273, Edwards, Calif.; Goddard Space Flight Center, Greenbelt, Md.; Langley Research Center, Hampton, Va.; Lewis Research Center, Cleveland 35, Ohio; Marshall Space Flight Center, Huntsville, Ala.

Equipment Maintenance Men. Experienced in service and repair of one or more of the following types of equipment: Moviolas, sound projectors, Mitchell, Bell & Howell and Arriflex cameras, lens testing and calibration, audio and electronics for magnetic recorders and amplifiers, lighting and electrical equipment, machine shop. Write fully—experience and salary required. A. Florman, Florman & Babb, 68 West 45 St., New York 36.

Résumés / Resumenes / Zusammenfassungen

Quelques aspects de la cinématographie à laps de temps et des arts qui s'y rattachent

Henry Roger [259]

La photographie à laps de temps a de nombreuses applications, notamment dans les domaines des recherches médicales, du droit, de l'industrie et de l'agriculture. Une discussion de recherches médicales décrit des études faites sur des cellules tant normales que malignes de tissu et de sang; des capillaires humains et des études sur des yeux humains avec un appareil photographique automatique "à mouvement oculaire." La photographie à laps de temps a également joué un rôle important dans les litiges de brevets. L'auteur rend compte aussi d'études microscopiques à températures basses et à températures élevées (congélation d'huile moteur et cuisson au four). Cette technique s'emploie également dans l'étude de la croissance des plantes.

Fonctionnement des vidicons sous conditions exceptionnelles d'ambiance extérieure

G. A. Robinson [264]

L'auteur rend compte de l'effet produit par certaines conditions exceptionnelles d'ambiance extérieure sur le fonctionnement des tubes vidicon actuellement sur le marché. On a constaté que l'augmentation de la température de la face avant du tube jusqu'à 90°C n'influe pas sur la définition, bien que le courant résiduel d'obscurité (courant présent sans excitation) s'en trouve augmenté; la sensibilité décroît si le courant d'obscurité est maintenu à une valeur constante. On donne des indications concernant les durées de surexcitation (application à la photocathode de rayonnements anormalement élevés) auxquelles se produit la rémanence d'image. Il a été établi que la verrerie de la plupart des tubes vidicon sur le marché résiste à des pressions allant jusqu'à 50 atmosphères. Quant aux radiations nucléaires, les seuls effets constatés ont été une réduction effective de la sensibilité due au brunissement du verre sur la face avant du tube.

Appareil automatique à copier des films de 35mm

Edward P. Kennedy, Joseph L. DeClerk et Domenic L. LaBanca [267]

Un équipement auxiliaire à commander le diaphragme d'un appareil à copier de marque "Bell & Howell" a été developpé et construit sous forme experimentale. A l'aide de cellules solaires au silicium, un voltmètre muni d'une aiguille à contacts et d'un émetteur "Selsyn" à 22 pas, la commande du diaphragme est varié selon l'opacité du négatif à copier. (*Tr. par B. Humbel*)

Des systèmes à convertisseur d'images No. 64 à cadences rapides de répétition de groupes-images

Robert W. King et John H. Hett [270]

Trois types différents d'appareils de prise de vues à convertisseur d'images ont été réalisés au cours de ces dernières années; bien qu'ils aient des caractéristiques variées, ils se signalent tous par des cadences d'exposition rapides. Ces trois appareils utilisent tous le tube convertisseur Mullard de type 1201 avec phosphore bleu de courte persistance pour l'enregistrement photographique. Le premier de ces appareils produit une série de six images rectangulaires qui ont un rapport d'allongement d'environ 5:1. Le temps d'exposition de 0,4 μsec et l'intervalle d'exposition de 5 μsec sont fixes. Cet appareil prend un groupe de six clichés à la fois avec un temps de rétablissement relativement long.

Le deuxième des appareils a des caractéristiques très poussées. Il donne six expositions sur un même cliché à des cadences qui varient de 2×10^6 à 2×10^4 expositions par seconde. La cadence d'images va de zéro à 5000, la limite supérieure dépendant des cadences d'exposition. Les temps d'exposition ont les valeurs suivantes: 0,1, 0,3, 1,0, 3,0 et 10,0 μsec. Le cycle opératoire des cadences de répétition et des temps d'exposition ne peut pas dépasser 20%. Le décalage de l'image a lieu sur les deux axes, ce qui a pour effect de produire deux rangées de chacune trois expositions.

Le troisième des appareils, qui est le plus récent, est analogue au deuxième; il a des temps d'exposition de 0,1, 0,3, 1,0, 3,0 et 10 μsec et des cadences d'exposition correspondantes de 2×10^6 et 2×10^4 expositions par seconde. Le générateur de pulsation de série et de pulsation d'obturateur est très similaire; toutefois, le mouvement circulaire est entièrement sur un même axe et partant semblable à celui du premier appareil décrit. La différence réside dans le mécanisme d'engendrement du mouvement circulaire car ici la forme de base de ce mouvement est produite par un circuit compteur avec diode à action de pompage. On a le choix de montures à 4 ou à 8 images.

Appareil de prise de vues électron-optique à grande vitesse pour l'étude des processus transitoires

V. S. Komelkov, Y. E. Nesterikhin et M. I. Pergament [275]

Ce système convertisseur d'images à déflexion électrostatique a des vitesses allant jusqu'à 5×10^6 images/sec et des temps d'exposition d'une brévité allant jusqu'à 5×10^{-8} sec. Le nombre d'images dans une sous-série peut être de 4 ou 8. Le nombre total d'images dans une série est de 16. Le temps d'exposition pour chaque image peut être varié pendant la série. La variation maximum d'exposition entre la 1ère et la 16ème image est un facteur de 20. Les dimensions de l'image sont de 5 mm × 5 mm. La résolution est de 30 lignes/mm. L'équipement peut aussi prendre une série de quatre enregistrements à stries à des intervalles réglables. L'article contient une discussion de l'ouverture relative utile du convertisseur, ainsi que des lentilles d'entrée et de sortie, pour diverses amplifications électriques et optiques.

Un nouveau type de caméra multi-images à combinaison de miroir tournant et de tambour de film

Tsuneyoshi Uyemura [280]

Le présent mémoire décrit trois nouvelles caméras multi-images chacune desquelles combine un miroir tournant à quatre faces de vitesse ultra-rapide à un tambour rotatif de film de faible vitesse. Caractéristiques typiques d'une caméra sont: un système d'enregistrement continu, une cadence de 120,000 images/s, 200 expositions par série, un temps d'exposition minimum de 1 μs, une commande à moteur du miroir tournant de 90,000 t/m, une commande à moteur de 900 t/m du tambour rotatif de film d'un diamètre de 60 cm, une ouverture effective de f/9, et des images de 5 mm × 20 mm. Une deuxième caméra semblable peut opérer à une vitesse deux fois plus grande. Le temps d'exposition peut être maintenu à la valeur minimum et 200 expositions par série sont possibles en faisant fonctionner l'appareil à une faible cadence d'images.

Utilisation de lampes explosives pour la photographie par le système Schardin

Louis Deffet et René Vanden Berghe [283]

Cette méthode par transparence apporte une solution à l'enregistrement photographique des phénomènes explosifs présentant un effet destructeur important et une luminosité propre très intense. Elle consiste essentiellement à remplacer les étincelles du système Cranz-Schardin par des lampes éclairs explosives situées dans l'air plutôt que dans l'argon. L'intensité du flux lumineux émis par ces lampes explosives a permis de combiner des conditions de prises de vues entrainant une élimination totale des uminosités parasites du sujet.

La synchronisation des différentes lampes explosives est assurée par du cordeau détonant. La fréquence de prise de vues peut atteindre 1.000.000 images par seconde avec un temps de pose per image le l'ordre de 10^{-1} μsec.

Unos aspectos de cinematografía á intervalos de tiempo y artes del mismo género

Henry Roger [259]

La fotografía á intervalos de tiempo tiene muchas aplicaciones en la investigación médica, juridica, industrial y agricultural. En una discusión sobre la investigación médica, se describe unos estudios de las células normales y malignas del tejido y de la sangre; estudios de los capilares humanos; y estudios de ojos humanos con una cámara de "movimiento del ojo" autimatica. Además la fotografía á intervalos de tiempo toma una parte importante en los litigios sobre unas patentes. El escritor discute unos estudios a las temperaturas bajas y elevadas (el helado del aceite para motores, y de la hornada). Se emplea, tambien, esta técnica en el estudio del crecimiento de plantas.

Funcionamiento de los vidicones en condiciones ambiente extraordinarias

G. A. Robinson [264]

Se da cuenta del efecto de ciertas condiciones ambiente extraordinarias en el funcionamiento de los vidicones de fabricación comercial. Se ha comprobado que aumentando hasta 90 grados centígrados la temperatura del vidrio del frente del tubo, no se afecta la resolución, aunque aumenta la corriente obscura (corriente sin excitación), y disminuye la sensibilidad si se mantiene constante la corriente obscura. Se aportan datos sobre las duraciones de las sobre-

excitaciones (aplicaciones al fotocátodo de radiaciones de intensidad superior a la normal) a las cuales se produce retención de la imagen. Se ha determinado que las ampollas de la mayoría de los vidicones de tipo comercial resisten presiones que no excedan de 50 atmósferas. El único efecto observado de la radiación nuclear es la reducción de sensibilidad resultante del obscurecimiento del vidrio del frente del tubo.

35 Milimetros automatica prensa fotografica

Edward P. Kennedy, Joseph L. DeClerk y Domenic L. LaBanca [267]

Equipo auxiliar ha sido diseñado y construído en una forma experimental que automaticamente controla la apertura de la prensa (La Prensa Hace Duplicados) del retrato original por medio de celdas solares usando silicio, un voltimetro de contactos y un sistema de veinte dos (22) pasos de un transmitidor selysn que controla la apertura de la prensa y varia de acuerdo con la densidad del negativo que va a ser duplicado, ó reproducido. (*Tr. de F. Alvarez*)

Unos sistemas para convertir las imagenes á unas cadencias rapidas de repetición de las imagenes en grupos

Robert W. King y John H. Hett [270]

Tres tipos diferentes de cámaras para convertir las imagenes han sido diseñado en unos años recientes y, aunque ellas tienen unos característicos varios, todas señalan unas cadencias rapidas de la exposición. Estas tres cámaras usan todas el tubo de conversión Mullard del tipo 1201 con el fosforo azúl de la persistencia corta para el registro fotográfico. La primera de estas cámaras produce una serie de seis imagenes rectangulas que tienen aproximativamente un razón de aspecto de 5:1. El tiempo de exposición de 0,4 μsec., y el intervalo de exposición de 5 μsec., fueron fijados. Esta cámara toma un grupo de seis exposiciones á la vez con un tiempo de recobro relativamente largo.

La segunda cámara tiene unos característicos muy avanzados. Ella hace seis exposiciones en una fotograma única á unas cadencias que varian de 2×10^6 hasta 2×10^4 exposiciones/ segundo. La cadencia de imagenes va de cero hasta 5000, el limite superior pendiendo de las cadencias de exposición. Los tiempos de exposición tienen los valores seguidos: 0,1, 0,3, 1,0, 3,0, y 10,0 μsec. El ciclo operativo de las cadencias de repetición y de los tiempos de exposición no pueden exceder 20%. El desvío de la imagen tiene efecto sobre los dos ejes que producen dos hileras, cada una de tres exposiciones.

La tercera cámara y la última es analógica á la segunda, teniendo unos tiempos de exposición de 0,1, 0,3, 1,0, 3,0 y 10 usec., y unas cadencias de exposición correspondiente de 2×10^6 hasta 2×10^4 exposiciones por segundo. El engendrador de pulsación de serie y de pulsación de obturador es muy similar; sin embargo, el giro es enteramente sobre un eje y por esto es similar á aquella de la primera cámara descrita. La diferencia es inherente en el mecanismo del engendramineto de giro porque aquí la forma básica de este movimiento es producido por un circuito contando con diode á acción de bomba. Hay un escogimiento de despliegues á 4 ó 8 imagenes.

Una cámara electron-optica de gran rapidez para la investigación de unos procedimientos transistores

V. S. Komelkov, Y. E. Nesterikhin y M. I. Pergament [275]

Este sistema para convertir las imagenes por el desvío electrostático tiene las velocidades hasta 5×10^6 fotogramas/segundo, y las exposiciones tan breve como 5×10^{-8} segundos. El número de las fotogramas en una subserie puede ser 4 ó 8. El número total de las fotogramas en una serie es 16. El tiempo de exposición para cada fotograma puede ser cambiado mientras que la serie dura. La variación maxima de exposición de la primera fotograma hasta la décimosexta es un factor de 20. El tamaño de una fotograma es 5 mm × 5 mm. La resolución es 30 lineas/mm. Esta cámara puede tomar, tambien, una serie de cuatro registros en rayas á intervalos sometido al imperio del operario. Se discute la razón efectiva entre la abertura y unos lentes de entrada y salida para las amplificaciones varias, electricas y opticas.

Una cámera de fotograma de un tipo nuevo de ultra gran rapidez combinando un espejo girando con un cilindro de película

Tsuneyoshi Uyemura [280]

Este papel describe tres cámaras nuevas de fotogramas, cada cual que combina un espejo rotador de cuatro lados de gran rapidez y un cilindro rotador de poca velocidad. Los aspectos tipicos de una cámara son: un sistema de escritura continua, 120.000 fotogramas por segundo, 200 exposiciones por el curso de operación, 1 μsec. del tiempo de exposición minimo, un espejo rotador manejado por motor á 90.000 rpm, un cilindro de película de diametro de 60 mm manejado por motor á 900 rpm, una abertura efectiva de f/9, un medido de fotograma de 5 mm × 20 mm. Una segunda cámara similar puede operarse a dos veces fotogramas por segundo. El tiempo de exposición puede ser mantenido al valor minimo, y 200 exposiciones por cada curso de operación puede ser tomado a las razones de fotogramas bajas. Una tercera cámara se está construyendo para tomar 2.000 fotogramas á 10^6 fotogramas por segundo.

El uso de lamparas explosivas para la fotografía del sistema Schardin

Louis Deffet y René Vanden Berghe [283]

Este método de transparencia trae una solución al registro fotografico de las fenomenas explosivas presentando un efecto destructivo importante y una luminosidad propia muy intensa. El consiste esencialmente de remplazar las chispas del método Cranz-Schardin con unas lamparas claras explosivas que están localizadas en el aire en vez de en argón. La intensidad del flujo luminoso suplido por estas lamparas han hecho posible colocar las condiciones de recordar, y eliminar completemente la luminosidad parisitica y blanda del objeto. La sincronización de unas varias lamparas explosivas está asegurada por el uso de una cuerda de detonación. La frequencia de tomado de vista puede ganar 1.000.000 de fotogramas por segundo a un tiempo de exposición del orden de 10^{-1} μsec., para cada imagen.

Zeitrafferkinematographie und deren verwandte Anwendungen

Henry Roger [259]

Die Zeitrafferkinematographie hat viele Anwendungen auf dem Gebiete der Wissenschaften, in der Medizin, in der Biologie, in der Chemie, in der Agricultur, sowie in der Industrie und in der Jurisprudenz. In diesem Artikel werden folgende Anwendungen der Zeitraffertechnik besprochen: In der medizinischen Forschung werden Arbeiten beschrieben mit normalen und krankhaften Gewebe- und Blutzellen, sowie am Blutlauf in menschlichen Kapillarblutgefässen. Ferner werden Studien an der menschlichen Augenbewegung unter Anwendung einer automatischen Kamera beschrieben. Die Zeitraffertechnik fand Anwendung in gerichtlichen Verfahren, ins besondere in Patentangelegenheiten; mikroskopische Gefriermethoden an Motorenöl, sowie mikroskopische Heizungsmethoden zur Darstellung des Backprozesses werden angeführt. Zeitraffergerät und dessen Anwendung z. B. in Wachstumstudien an Pflanzen wird beschrieben. (*Ub. von Henry Roger*)

Die Verwendung von Vidikonröhren unter ungewöhnlichen Aussenverhältnissen

G. A. Robinson [264]

Der Artikel beschreibt den Einfluss ungewöhnlicher Aussenverhältnisse auf die Leistungsfähigkeit handelsüblicher Vidikonröhren. Es hat sich gezeigt, dass eine Erwärmung des Schirmträgers auf 90°C die Auflösung nicht beeinflusst, obwohl sie den Dunkelstrom erhöht und, wenn dieser konstant gehalten wird, die Empfindlichkeit herabsetzt. Es werden Daten für verschiedene Betriebszeiten unter übernormaler Photokathodenstrahlung gegeben, bei denen Bildkonservierung hervogerufen wird. Es hat sich ferner gezeigt, dass die Kolben der meisten handelsüblichen Arten von Vidikonröhren einen Druck bis zu 50 Atm. aushalten können. Der einzige Einfluss von Kernstrahlung, der beobachtet wurde, war eine-durch ein Bräunen des Schirmträgerglases verursachte-Herabsetzung der Empfindlichkeit.

Automatische Kopiereinrichtung für 35mm Filme

Edward P. Kennedy, Joseph L. DeClerk und Domenic L. LaBanca [267]

Ein Zusatzgerät zur automatischen Steuerung des optischen Verschlusses eines Bell & Howell Kopierapparates wurde entwickelt und in experimenteller Form ausgeführt. Mittels einer Silizium Photozelle, eines mit einem Stufenschalter kombinierten Voltmeters und eines 22 stufigen Servogetriebes wird die Blendenöffnung der Kopiereinrichtung entsprechend der Durchlässigkeit des kopierenden Negativs variiert. (*Ub. von Dr. G. Goubau*)

Bildwandlersysteme mit rascher Bildgruppenwiederholung

Robert W. King und John H. Hett [270]

Während der allerletzten Jahre wurden drei verschiedene Arten von Bildwandlerkameras entworfen, die zwar verschiedene Charakteristiken aufweisen, die aber alle eine schnelle Belichtungsfolge als Hauptmerkmal haben. Alle drei Kameras arbeiten mit der Mullard Wandlerröhre Mod. 1201 mit dem blauen Phosphor kurzer Beharrlichkeit für photographische Aufzeichnung. Die erste Kamera liefert eine Reihe von 6 rechteckigen Bildern im Formatverhältnis von ungefähr 5:1. Die Belichtungszeit von 0,4 Mikrosekunden und der Belichtungsintervall von 5 Mikrosekunden sind unveränderlich. Diese Kamera nimmt eine Gruppe von 6 Aufnahmen auf einmal auf und hat eine verhältnismässig lange Rückführungszeit.

Die zweite Kamera ist bedeutend moderner; sie nimmt sechs Aufnahmen auf ein einziges Bild mit Geschwindigkeiten, die sich zwischen 2×10^6 und 2×10^4 Aufnahmen/s bewegen. Die Bildgeschwindigkeit ist von 0 bis zu 5000, wobei die obere Grenze von den Belichtungsgeschwindigkeiten abhängt. Die Belichtungszeiten zeigen die folgenden Werte: 0,1; 0,3; 1,0; 3,0 und 10,0 Mikrosekunden. Wiederholungsgeschwindigkeiten und Belichtungszeit-Arbeitszyklus dürfen 20% nicht überschreiten. Die Ablenkung des Bildes erfolgt an beiden Achsen und ergibt zwei Reihen von je drei Belichtungen.

Die dritte und neueste Kamera-Bauart ist der zweiten ähnlich und hat Belichtungszeiten von 0,1; 0,3, 1,0; 3,0 und 10 Mikrosekunden und dementsprechend Aufnahmefolgen von 2×10^6 und 2×10^4 Aufrahme/s. Der Impulsgenerator für den Sequenz-Impuls und den Verschluss-

Impuls ist sehr ähnlich. Das Absuchen jedoch geschieht vollkommen einachsig und daher ähnlich mit der erstbeschriebenen Kamera. Der Mechanismus für die Absuchbewegung ist jedoch ganz verschieden und die grundlegende Absuchform wird durch einen Zählstromkreis mit Diodenpumpe geschaffen. Es können nach Wahl 4 oder 8 Bilder gezeigt werden.

Elektronisch-optische Zeitlupenkamera zur Untersuchung kurz dauernder Vorgänge

V. S. Komelkov, Y. E. Nesterikhin und M. I. Pergament [275]

Dieses Bildwandlergerät mit elektrostatischer Deflektion gibt Geschwindigkeiten bis zu 5×10^6 Aufnahmen/Sek. und Belichtungszeiten einer Kürze bis zu 5×10^{-8}/Sek. Eine Untergruppe von Aufnahmen enthält entweder 4 oder 8 Bilder und eine ganze Reihe enthält insgesamt 16 Aufnahmen. Die Belichtungsdauer jeder Aufnahme innerhalb der Reihe ist einstellbar und die Veränderung von der 1. bis zur 16. Aufnahme entspricht maximal einem Faktor von 20. Die Bildgrösse ist 5×5mm und die Auflösung ist 30 Linien/mm. Das Gerät kann auch eine Reihe von 4 Schlierenaufnahmen mit veränderlichen Intervallen geben. Der Artikel enthält weiterhin eine Abhandlung über die wirksame relative Blendenöffnung des Bildwandlers und der Aufnahme- und Darstellungslinsen für verschiedene elektrische und optische Vergrösserungen.

Eine neue Hochfrequenz-Bildreihenkamera kombiniert einen rotierenden Spiegel mit einer Filmtrommel

Tsuneyoshi Uyemura [280]

Dieser Artikel beschreibt drei neue Bildreihenkameras, deren jede einen mit Höchstfrequenz rotierenden 4-flächigen Spiegel mit einer langsam rotierenden Filmtrommel kombiniert. Einer von diesen Kameras gehören folgende Merkmale: kontinuierliche Aufnahme, Bildfrequenz 120.000/s, 200 Aufnahmen je Lauf, 1 μs Minimalbelichtungszeit, Rotationsspiegelantrieb 90.000 Umdrehungen/m, Motorantrieb der rotierenden Filmtrommel 900 Umdrehungen/m, wirksame Öffnung 1:9, Bildgrösse von 5×20 mm. Eine zweite, ähnliche Kamera gibt zweimal so grosse Bildfrequenz. Die Belichtungszeit kann bei ihrem Minimalwert und 200 Aufnahmen je Lauf beibehalten werden, auch wenn mit niedriger Bildfrequenz gearbeitet wird. Eine dritte Kamera wird jetzt erzeugt, die 2000 Aufnahmen bei einer Bildfrequenz von 10^6 Sekunden machen soll.

Die Verwendung von Sprengstofflampen für die Photographie nach der Schardin-Methode

Louis Deffet und Rene Vanden Berghe [283]

Diese Transparenz-Methode ermöglicht es photographische Aufzeichnungen von Explosionsphänomenen zu machen, die eine bedeutende Zerstörungskraft und eine sehr intensive Eigenluminosität haben. Sie besteht in der Hauptsache darin, dass die Funken der Cranz-Schardin Methode durch Sprengstoff- Blitzlampen ersetzt werden die sich in einer Luft- eher als in einer Argon-Atmosphäre befinden. Die Intensität des durch diese Lampen gelieferten Lichts ermöglichte es, die aufzunehmenden Umstände zu kombinieren, wodurch parasitische Luminositäten des Objekts vollkommen ausgeschaltet wurden. Die Synchronisierung der verschiedenen Sprengstofflampen wird durch Verwendung einer detonierenden Zündschnur gesichert. Die Bildgeschwindigkeit kann 1.000.000 Aufnahmen/s bei einer Belichtungszeit der Grössenordnung 10^{-1} Mikrosekunde je Aufnahme erreichen.

Ed. Note: Since last January we are publishing in the *Journal* as a regular feature translations of the titles and abstracts of all papers in French, German and Spanish. This is intended to increase the *Journal's* usefulness to the Society's growing number of non-English speaking members and subscribers overseas. Comments of readers are invited. The Society is particularly anxious that the translations used should be of the best quality obtainable, therefore comments on their quality and suggestions for their improvement would be especially welcome. Also, since the cost of buying all the translations from a commercial translator is prohibitive, any assistance that may be volunteered in obtaining translations for the *Journal* will constitute a very considerable contribution to the Society. Contributors will of course, be given full acknowledgment in the *Journal.*

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Meeting Calendar

Electrochemical Society, Symposium, Apr. 30–May 4, Claypool Hotel, Indianapolis, Ind.
ISA, 7th National Aero-Space Instrumentation Symposium, May 1–4, Fort Worth, Tex.
AICE, National Meeting, May 7–10, Sheraton-Cleveland Hotel, Cleveland, Ohio.
89th Semiannual Convention of the SMPTE, May 7–12, King Edward Sheraton, Toronto.
SPSE, Annual Conference, May 22–26, Arlington Hotel, Binghamton, N.Y.
AIEE, IRE, Association for Computing Machinery, Western Joint Computer Conference, May 9–11, Ambassador Hotel, Los Angeles.
Acoustical Society of America, Spring Meeting, May 11–13, Bellevue-Stratford Hotel, Philadelphia.
IRE Professional Group on Microwave Theory and Techniques, National Symposium May 15–17, Sheraton-Park Hotel, Washington, D.C.
AIEE, ARS, IAS, IRE, ISA, National Telemetering Conference, May 22–24, Sheraton Towers Hotel, Chicago.
IRE, AIEE Global Communications Symposium, May 22–24, Sherman Hotel, Chicago.
American Society for Quality Control, Annual Convention and Exhibition, May 22–24, Sheraton Hotel, Philadelphia.
ISA, Summer Instrument-Automation Conference, June 6–8, Royal York Hotel and Queen Elizabeth Hall, Toronto, Ont.
ASME, Summer Annual Meeting, June 11–14, Statler Hilton Hotel, Los Angeles.
AIEE, Summer General Meeting, June 18–23, Ithaca, N.Y.
American Rocket Society, Institute of the Aerospace Sciences, Joint Midyear Meeting, June 19–22, Los Angeles.
American Physical Society, Meeting, June 22–24, Univ. of Mexico, Mexico City, Mex.
IRE, National Convention on Military Electronics, June 26–28, Shoreham Hotel, Washington, D.C.
AIChE, AIEE, ASME, IRE, ISA, Joint Automatic Control Conference, June 28–30, Univ. of Colorado, Boulder, Colo.
British IRE, Annual Convention, July 5–9, Christ Church, Oxford, England.
IFME, JECMB, IRE-PGBME, 4th International Conference on Medical Electronics and 14th Conference on Electronic Techniques in Medicine and Biology, July 9–14, Waldorf-Astoria Hotel, New York.
NAVA, Annual Convention, July 22–25, Hotel Morrison, Chicago.
American Rocket Society, Guidance and Control Conference, Aug. 7–9, Stanford Univ., Stanford, Calif.
SPIE, National Convention, Aug. 7–10, Ambassador Hotel, Los Angeles.
Western Electronic Show and Convention, Aug. 22–25, San Francisco.
American Chemical Society, 6th International Conference on Coordination Chemistry, Aug. 27–Sept. 1, Wayne State Univ., Detroit, Mich.
UFPA, Annual Meeting, August 1961, Berkeley Campus, U. of California.
American Chemical Society, National Meeting, Sept. 3–8, Chicago.
IRE, National Symposium on Space Electronics and Telemetry, Sept. 6–8, Albuquerque, N.M.
PGIT, International Symposium on Transmission and Processing of Information, Sept. 6–8, MIT, Cambridge, Mass.
AIEE, ISA, IRE, Joint Nuclear Instrumentation Symposium, Sept. 6–8, North Carolina State College, Raleigh, N.C.
ISA, Fall Instrument-Automation Conference and Exhibit, Sept. 11–15, Memorial Sports Arena, Los Angeles.
Standards Engineers Society, Annual Meeting, Sept. 18–20, Hotel Sherman, Chicago.
IRE, AIEE, Industrial Electronics Symposium, Sept. 20–21, Boston, Mass.
Illuminating Engineering Society, National Technical Conference, Sept. 24–29, Chase-Park Plaza Hotel, St. Louis, Mo.
Electrochemical Society, Fall Meeting, Oct. 1–5, Statler Hotel, Detroit, Mich.
IRE, Canadian Electronic Conference, Oct. 2–4, Automotive Bldg., Exhibition Park, Toronto, Ont.
90th Semiannual Convention of the SMPTE, Oct. 2–6, Lake Placid, N.Y.
National Electronics Conference, Oct. 9–11, International Amphitheatre, Chicago.
American Standards Association, National Conference, Oct. 10–12, Rice Hotel, Houston, Texas.
Society of Reproduction Engineers, Visual Communications Congress, Dec. 1–4, Hotel Biltmore, Los Angeles.
91st Semiannual Convention of the SMPTE, Apr. 30–May 4, 1962, Ambassador Hotel, Los Angeles.
92nd Semiannual Convention of the SMPTE, Oct. 22–26, 1962, Drake Hotel, Chicago.
93rd Semiannual Convention of the SMPTE, Apr. 22–26, 1963, Traymore Hotel, Atlantic City, N.J.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections, Subsections and Chapters and of the Committee Chairmen and Members appear in this issue of the Journal, pp. 288–296.

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of the Society of Motion Picture and Television Engineers

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- Advance in the theory and practice of engineering in motion pictures, television and the allied arts and sciences;
- Standardization of equipment and practices employed therein;
- Maintenance of high professional standing among its members;
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- Dissemination of scientific knowledge by publication.

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